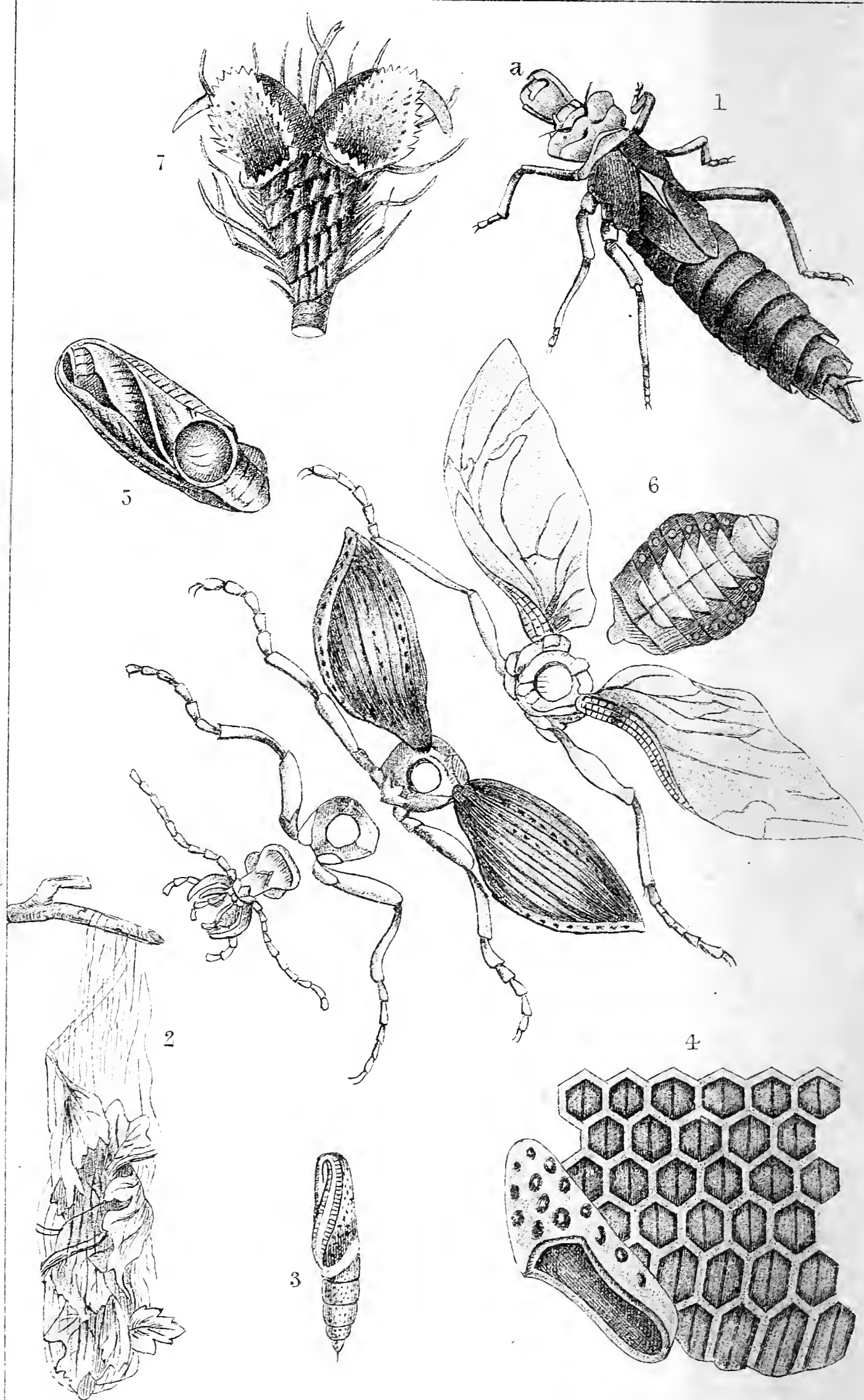






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THE
INSECT WORLD;

OR,
A BRIEF OUTLINE

OF
THE CLASSIFICATION, STRUCTURE,
AND ECONOMY OF INSECTS.

“The wisdom of the Workman is commonly perceived in that
which is of little size.”

ST. BASIL.

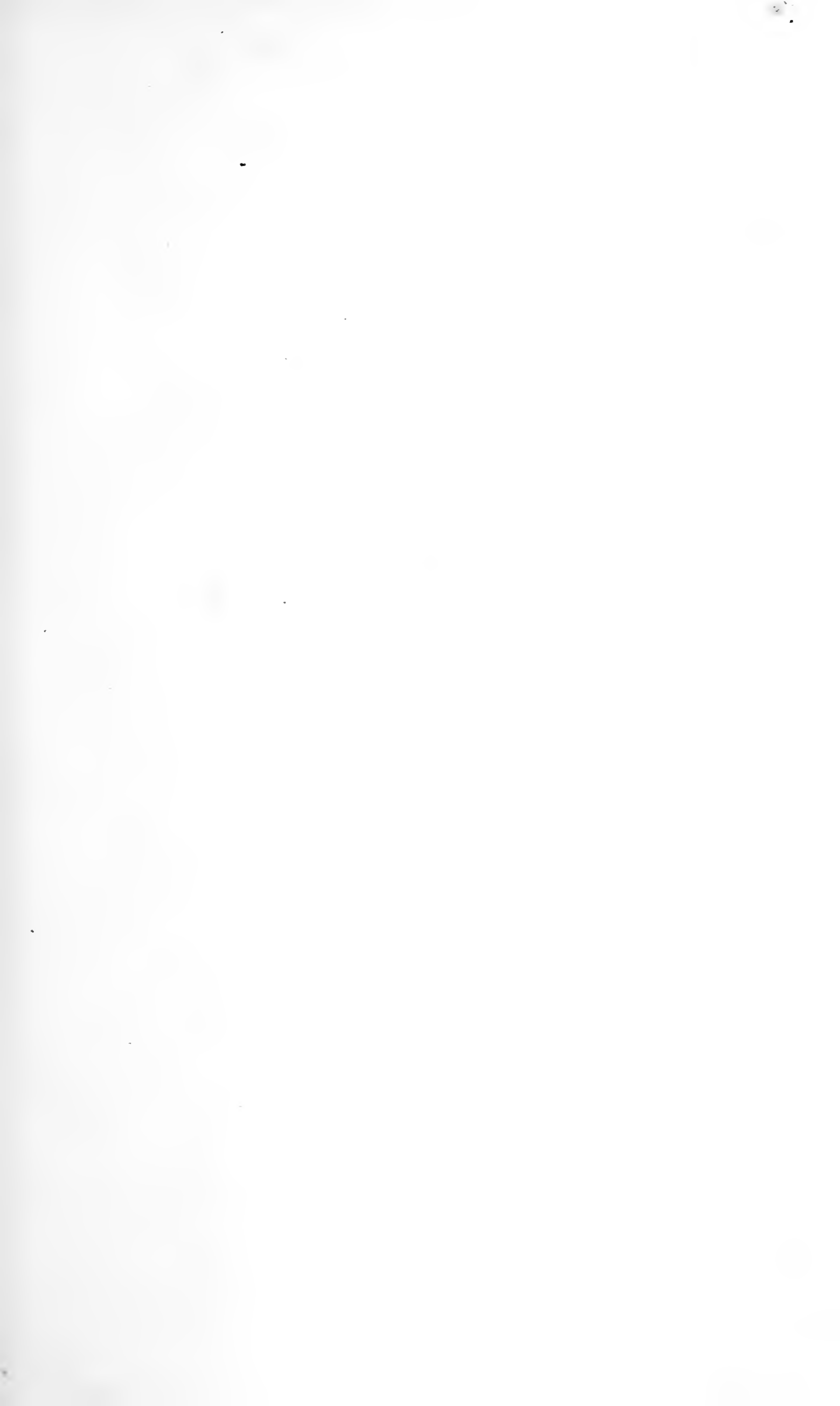
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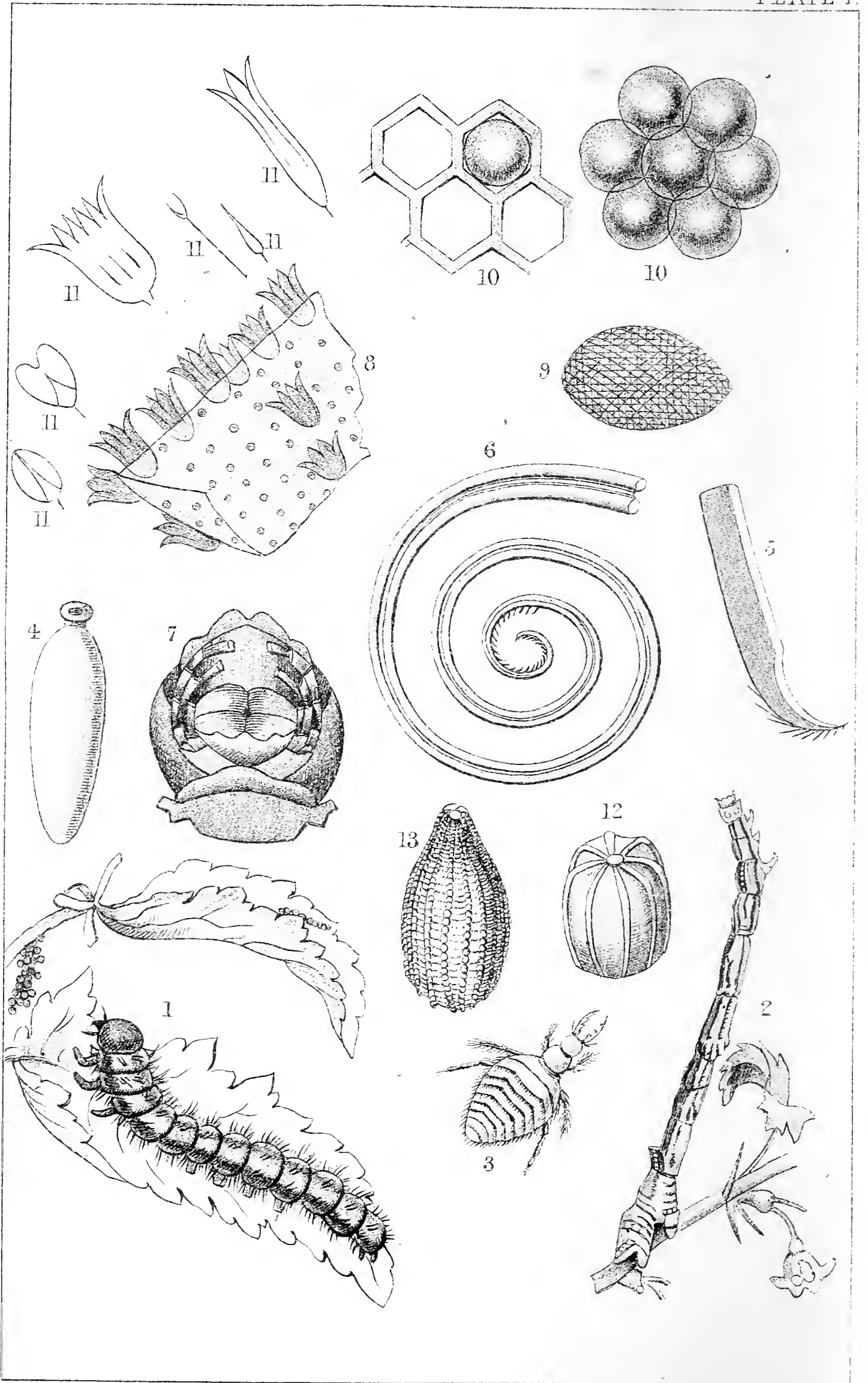
MDCCCXLIII.

BISHOPS STORTFORD:
PRINTED BY J. M. MULLINGER.

THE design of this little volume is to induce those young persons who deem the Insect Inhabitants of the earth fit rather for "cleanly riddance," than for curious regard, more attentively to observe the exquisite structure and astonishing instincts which they display. A close examination of the wonders revealed in the Insect World cannot fail to produce the conviction, that the power, the wisdom, and the superintending providence of God, are as truly manifested in the meanest fly that sports upon the gale, as in the magnificent forms and high endowments of the most exalted of created beings.

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DESCRIPTION OF THE PLATES.

PLATE I.

- Fig. 1.* Caterpillar of Nettle-butterfly, (*Papilio urtica.*)
2. Caterpillar of *Phalæna Grossulariata* (*Geometer caterpillar.*)
3. Larva of Ant-lion:
4. Egg of Gnat, highly magnified.
5. One lancet of the Proboscis of the Gnat, highly magnified.
6. Spiral Tongue of a Butterfly, highly magnified.
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8. Part of the Membrane of a Nettle-butterfly's Wing magnified, with a few Feathers on each side of it.
9. Magnified Eye of a Fly.
10. Part of a Butterfly's Eye, magnified 200,000 times.
11. Magnified Feathers from various Butterflies.
12. Magnified Egg of a Nettle-butterfly.
13. Ditto of Cabbage-butterfly.

PLATE II.

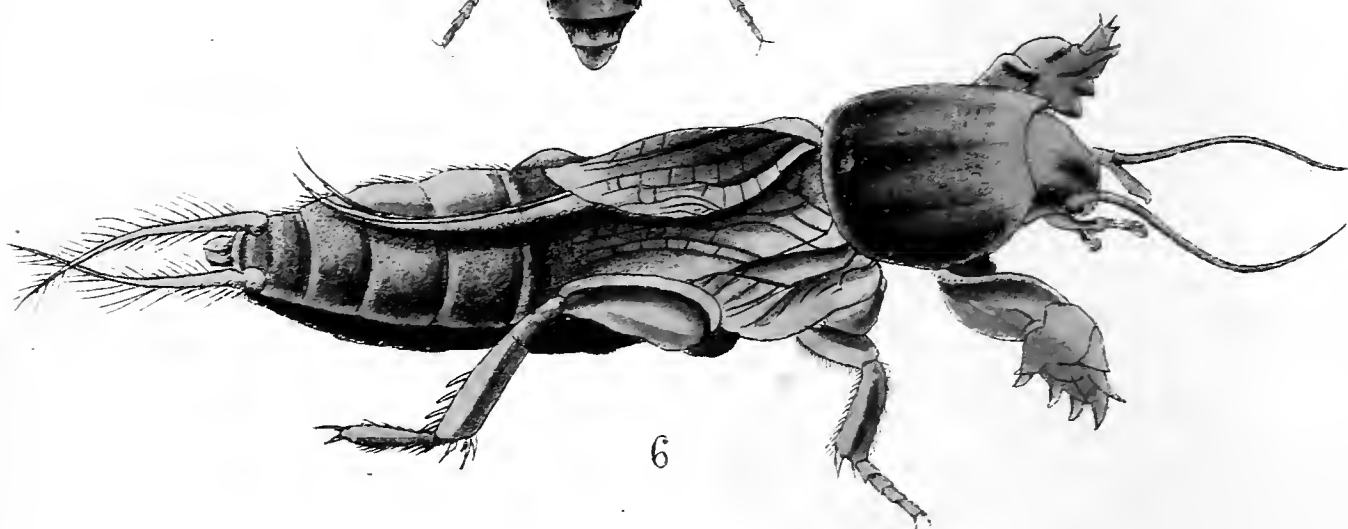
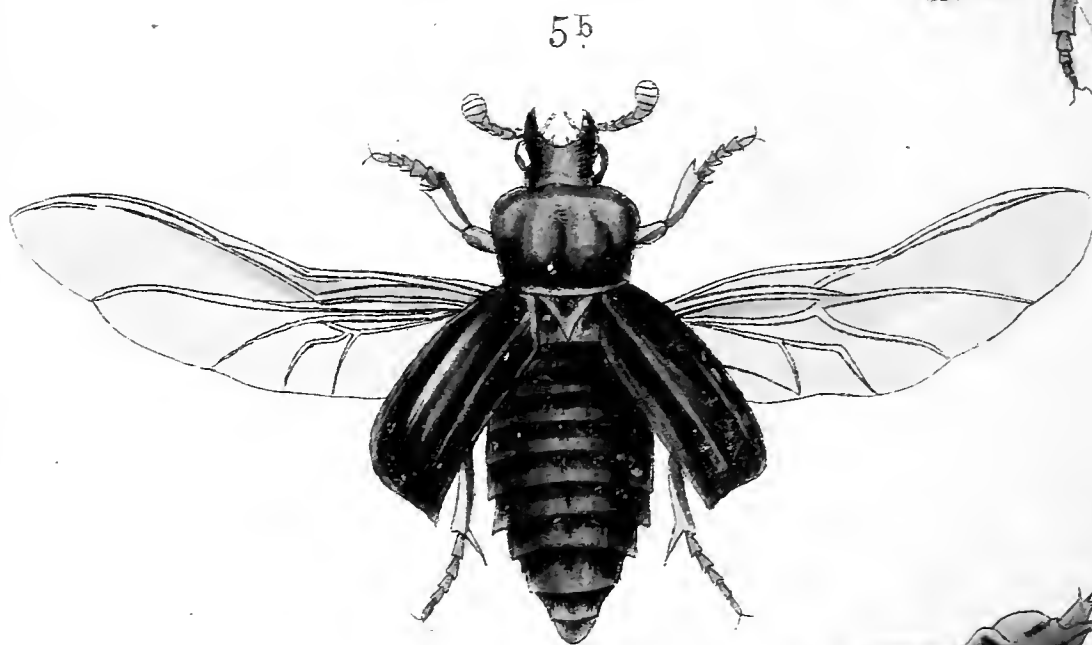
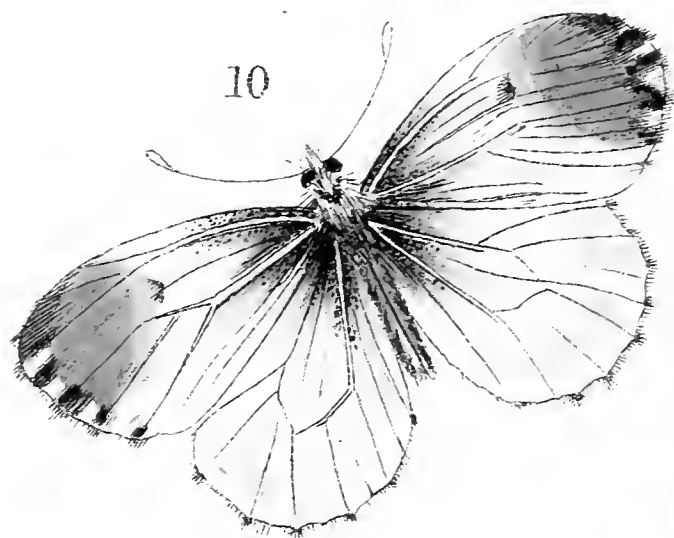
- Fig. 1.* Larva of Dragon-fly. *a.* The Mask.
2. Leafy Cocoon of *Phalæna Grossulariata*.
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12b. ————— Crane-fly, (*Pedicia rivosa*.)

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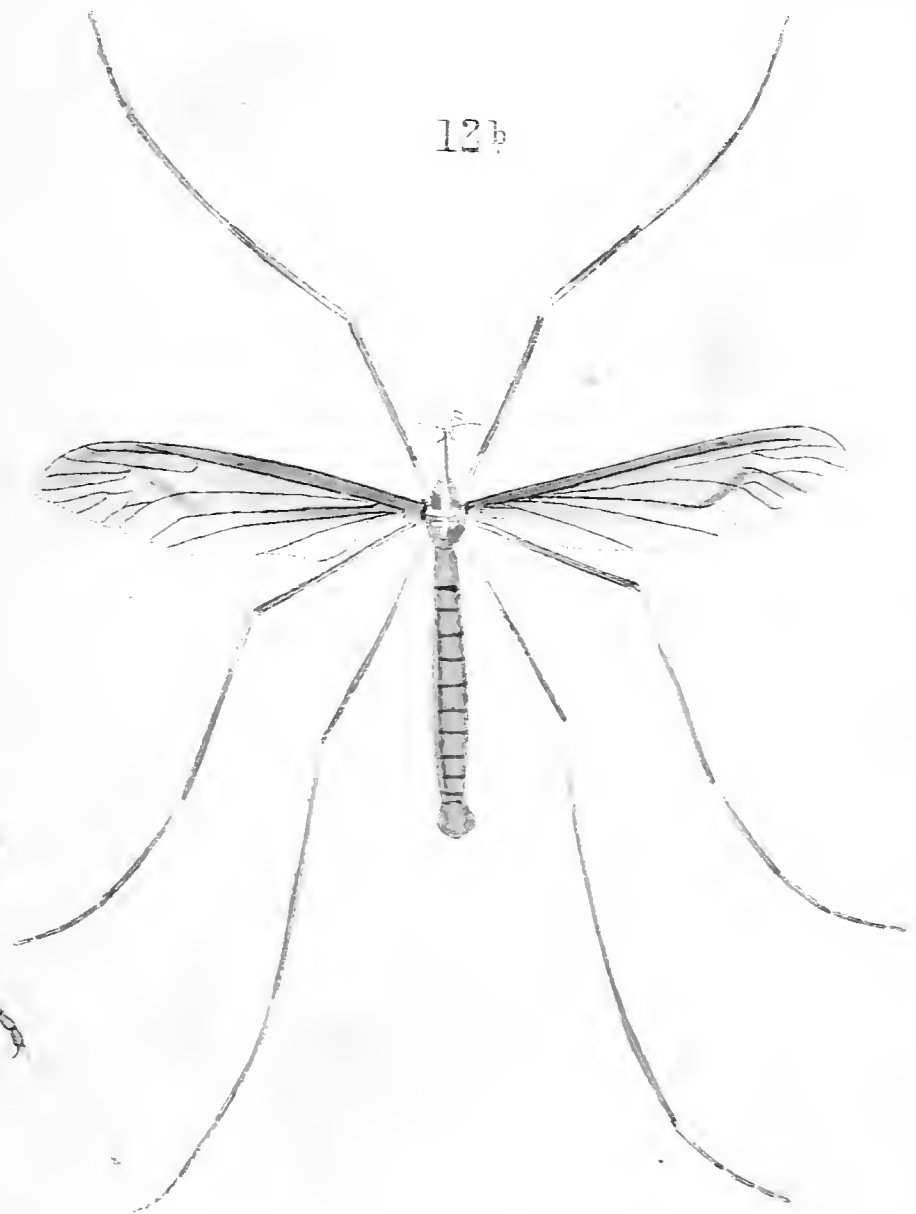


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O U T L I N E
OF
BARON CUVIER'S CLASSIFICATION
OF
INSECTS & ARACHNIDÆ;
WITH EXAMPLES OF EACH ORDER.

INSECTS.

- Order 1. *Myriapoda*,—Wood-lice, Scolopendræ, &c.
2. *Thysanoura*,—Spring-tails, &c.
3. *Parasita*,—Lice.
4. *Suctoria*,—Fleas.
5. *Coleoptera*,—Beetles, Lady-birds, Fire-flies,
Glow-worms, &c.
6. *Orthoptera*,—Grass-hoppers, Crickets, Locusts,
Earwigs, Mantes, Cock-roaches, &c.
7. *Hemiptera*,—Bugs, Water-boatmen, Cicadæ,
Lantern-flies, Aphides, Cocci, &c.
8. *Neuroptera*,—Dragon-flies, Ant-lions, Lace-
flies, White Ants, Ephemeræ, Phryganeæ,
&c.
9. *Hymenoptera*,—Bees, Ants, Wasps, Ichneumon-
flies, Gall-insects, &c.
10. *Lepidoptera*,—Butterflies, Silk-worms, Moths,
&c.
11. *Rhipiptera*,—Xenos, Stylops.
12. *Diptera*,—Gnats, Mosquitoes, House-flies,
Gad-flies, Crane-flies, &c.

ARACHNIDÆ.

- Order 1. *Pulmonaria*—Spiders, Tarantulæ, Scorpions.
2. *Trachearia*,—Mites, Shepherd's Spiders, &c.

THE INSECT WORLD.

FIRST EVENING.

Folly of prejudice against insects—Their various claims on our notice—Estimated number of distinct species—Probability that their metamorphoses suggested many of the fables of the Poets, and the doctrine of a metempsychosis—The Butterfly's Birth-day.

Oh! there is an earwig! said Emma B. jumping from her seat. Disagreeable things, how I hate them! I wish I could destroy them all.

And every insect in existence;—you had better clear the earth of them all at once, said her brother Frederick, laughing.

EMMA.

Well, Frederick; it would be a good thing, I think, if I could. Insects are odious creatures; I cannot bear them.

FREDERICK.

You would soon have cause to wish for them

back again, I fancy; not even excepting the “disagreeable earwigs.” For my part I consider them a most useful and ornamental part of creation: to say the truth, I am very fond of them.

EMMA.

Fond of *insects*! Frederick; I am sure nobody in their senses can ever be *fond* of such disagreeable things.

FREDERICK.

You put me in mind, Emma, of a law-case I was reading lately, which occurred nearly two hundred years ago, when people generally were about as wise on this subject as you are now. It was an attempt to set aside a lady’s will on the ground of lunacy, of which the only symptom alleged was her taste for collecting butterflies. You would have pronounced a verdict against her without hesitation, I suppose. And yet I have often heard you admire the collection in the Study.

EMMA.

O those are dead and cannot annoy any one; besides they are so pretty; they are very different from the odious things that are always buzzing and crawling about.

MR. B.

What is that I just now heard about odious things that are always buzzing and crawling about? Who is speaking of my little favourites in that manner?

EMMA.

Papa! your *favourites*! you are joking now.

MR. B.

No indeed, Emma, I am not. And if instead of indulging in the silly prejudices against insects, so common to young ladies, you would examine their history a little, I think they would soon become your favourites too.

You are fond of botany; I have often been pleased to observe your skill and diligence in collecting and drying specimens, and I think your *hortus siccus* does you great credit; but the botanist, Emma, who is not also an entomologist, is like a traveller who should content himself with describing countries, without taking any notice of their inhabitants.

Entomology has indeed attractions which botany cannot boast. A new plant is seldom to be met with, even by those who have opportunities for the most extensive researches;

but the study of insects presents an inexhaustible fund of new and pleasing entertainment: every pool, every stone, every tree or plant, affords fresh subjects for curious examination; and how often soever our researches may be made, we shall never have exhausted this source of interesting amusement.—But here comes Mamma.

I am reasoning with your daughter, my dear, on the dislike to insects, which I am surprised to find her entertaining; I should certainly have given her credit for more taste and good sense.

MRS. B.

I have often regretted the foolish prejudice which Emma has unhappily imbibed against this beautiful and elegant part of creation. She has learned it, I suspect, from some of her young companions at school. It is a great pity that girls who display good sense on other subjects, and even some sensible women too, should exhibit on this such unaccountable weakness.

I well remember once sitting in company with a party of very intelligent women, when an unfortunate spider made its appearance on the hearth-rug. The sudden entrance of a tiger could scarcely have occasioned more consternation. “Oh!

there is a spider!" one of them exclaimed; and in a moment they all jumped up on their chairs for safety, while I was left to encounter the terrific intruder alone.

FREDERICK.

I wish I had been there. How I should have laughed to see them!

MRS. B.

Prejudice originates in ignorance: and perhaps the best method of correcting these prejudices in Emma, if you could spare the time for it, would be to give her some instruction on the subject. Could you now and then afford us an evening for the purpose?

MR. B.

I would willingly make any effort to correct in my dear girl a foible of so injurious a tendency, and shall be most happy to attend to your suggestion whenever I can find a leisure hour. She is interested in botany; but, as I have just been telling her, without an acquaintance also with those little inhabitants that confer animation on every tree, and shrub, and flower, I might add on every stream, and every stone, she will enjoy but half the gratification it might afford her.

I ask, for my part, no clearer proof of the existence of an infinitely wise, skilful, and beneficent Creator than that which may be derived from the study of insects. As St. Basil beautifully says, “If you speak of a fly, a gnat, or a bee, your conversation will be a sort of demonstration of his power whose hand formed them.”

They present too a most striking and delightful proof of the minuteness of God’s providential care; for we find that the structure, the food, the habitations, even of those of whose existence we were ignorant till the microscope discovered them, are regulated and provided in a manner as complete as those of the largest and apparently most favoured creatures. Surely we may infer from this, that nothing in which we are interested is too small to be regarded by his eye, and accomplished by his love.

MRS. B.

The smallest insects are as exactly finished as the most graceful beasts, or the birds of the brightest plumage, and often even more gaily ornamented.

MR. B.

Your favourite writer, Mr. Kirby, I think says,

“These little creatures appear to have been Nature’s favourite productions, in which, to manifest her power and skill, she has combined and concentrated almost all that is either beautiful and graceful, interesting and alluring, or curious and singular in every other class and order of her children. To these, her valued miniatures, she has given the most delicate touch and highest finish of her pencil. Numbers she has armed with glittering mail, which reflects a lustre like that of burnished metals; in others she lights up the radiance of polished gems. Some she has decked with what looks like liquid drops or plates of gold and silver; or with scales or pile which mimic the colour and emit the rays of the same precious metals. To some she has given fins like those of a fish, or a beak resembling that of birds; to others, horns, nearly the counterparts of those of various quadrupeds. The bull, the stag, and even the vainly-sought-for unicorn, have, in this respect, many representatives among insects. One is armed with tusks, not unlike those of an elephant; another is bristled with spines, as the porcupine and hedgehog with quills; another has the disproportionate legs of the kangaroo; and a fourth the threatening head of a snake.

The amazing variety both of ornament and form observable in the insect world is indeed an endless subject of interesting remark. And when we consider that in the structure, even of the smallest of them, there are many more component parts than in the enormous living masses of the elephant or the whale, and observe also the agility of their movements, their stratagems, their address, their skill, and their industry, we are lost in astonishment at the infinite wisdom and skill of their almighty Maker.

EMMA.

I had no idea, Papa, that any thing so interesting could be said of insects. I begin to think I should like to know more about them.

MR. B.

In introducing you to an acquaintance with insects, my love, I shall introduce you to an acquaintance with the first geometricians, the first architects, the first miners, the first weavers, the first employers of diving-bells and air-pumps, the first paper-makers; indeed, with the first practisers of various arts on the invention of which man vainly prides himself.

It is not perhaps too much to say, that many of these tiny operatives, the bee and the ant for example, make a much nearer approach to the intellectual superiority of man than any others of the animal creation.

It may also be safely asserted, that the influence of insects in the economy of nature is greater than that of any other of the inferior classes. They hold a kind of universal empire over the earth and its inhabitants; an empire to which even the proudest monarchs have been forced to bow. Often have their desolating hosts laid waste extensive provinces, bringing in their train pestilence and famine. "Before them," as the prophet Joel speaks, "has been the garden of Eden; and behind them, a desolate wilderness."

But though sometimes the ministers of God's displeasure, their more usual office is that of agents of his mercy. Unceasingly diligent in the province assigned them, they preserve the earth, the water, and the air, in a state of sufficient purity for the habitation and the use of man; and hence have been very properly termed, "*The great scavengers of nature.*"

FREDERICK.

Do you know, father, what is the number of distinct species of insects?

MR. B.

The number of distinct species already known and described cannot be estimated at less than twenty thousand; and there can be no doubt that numbers have escaped observation, and have never yet been described. This is perhaps the case even with British insects; with respect to exotics, we may well believe that our catalogues are far from being complete. Beauty of colour, or singularity of form, has generally directed the choice of travellers in making their collections; to the neglect of multitudes whose humbler guise or more retiring habits have concealed them from observation.

FREDERICK.

The insects of different countries vary very much, do they not?

MR. B.

Yes: the different species of insects, like those of vegetables, are circumscribed within geographical limits. Those of the East Indies, generally speaking, differ essentially from those of the West

Indies, and the insects of Africa from both of these; the insects of temperate regions differ again from those of the torrid zone; and each region of the temperate zone has its own peculiar insects, which are rarely found elsewhere.

The intertropical countries, covered with immense forests, the trees of which are watered by a superabundant dew, are by far the most rich in these brilliant ornaments of nature: Brazil and Guiana are especially distinguished by the number and beauty of their insect inhabitants, and in this respect may perhaps be said to excel all other parts of the world. Many of the most beautiful specimens in my cabinet are from thence.

MRS. B.

The metamorphoses of insects are to me among the most wonderful occurrences of creation.

MR. B.

They are truly astonishing. That the animal, which, a few months ago was a wormlike caterpillar, slowly crawling on the plant whence it derived its nourishment, should be now furnished with embroidered wings,

“Through fields of air prepared to sail,”
is so wonderful a fact, that were it not for its

continual recurrence, and the minuteness of the objects in which it takes place, it would be viewed by all with eager curiosity and astonishment.

Some have conjectured, and I think with a great appearance of probability, that the first idea of the marvellous metamorphoses which the poets recount, originated in an observation of the wonderful changes effected in the insect world; and that the doctrine of the metempsychosis, or transmigration of souls from one body to another, took its rise also from the same source.

I am the more disposed to think this conjecture right, from a quotation I have met with from the Institutes of Menu, which are held in high veneration by the Hindoos.

In these Institutes it is declared, that “A priest who hath drunk wine, shall migrate into a moth or fly, feeding on ordure. He who stealeth the gold of a priest, shall pass a thousand times into the bodies of spiders. If a man shall steal honey, he shall be born a great stinging gnat; if oil, an oil-drinking beetle; if salt, a cicada; if a household utensil, an ichneumon fly.”

MRS. B.

Thus the ignorant heathen, wandering among

the wilds of an exuberant imagination, with no better light than that of human reason to guide them, misinterpret the wonders of nature; and deduce, from the most striking proofs of divine power and goodness, theories dishonourable to God, and degrading to man.

MR. B.

And deduce them too from those very facts which, when viewed in the light of divine revelation, most pleasingly suggest to the christian's mind the thought of that last, grand hope to which the gospel points.

FREDERICK.

You mean the Resurrection.

MR. B.

Yes: I never witness these changes without being powerfully reminded of that glorious day when this mortal shall put on immortality; and feeling disposed to ask with the Apostle, Why should it be thought a thing incredible that God should raise the dead?—that that divine energy, which thus continually revivifies nature, and reproduces beings, after a period of death-like repose, in forms so totally different from those under which they had previously existed, should also change

these vile bodies, and raising them to a new life, should adorn them with a beauty and glory, and endow them with capacities and faculties of which, in our present state, we can form no conception.

MRS. B.

You just now quoted a line from my favourite little piece, *The Butterfly's Birth-day*. The poem would please the young folks; perhaps you will favour us by reciting it.

MR. B.

With pleasure.

The shades of night were scarcely fled ;
The air was mild, the winds were still ;
And slow the slanting sunbeams spread
O'er wood and lawn, o'er heath and hill :

From fleecy clouds of pearly hue
Had dropt a short but balmy shower,
That hung like gems of morning dew
On every tree and every flower :

And from the blackbird's mellow throat
Was pour'd so loud and long a swell,
As echoed with responsive note
From mountain side and shadowy dell :

When, bursting forth to life and light,
The offspring of enraptured May,
The BUTTERFLY, on pinions bright,
Launch'd in full splendour on the day.

Unconscious of a mother's care,
 No infant wretchedness she knew ;
 But as she felt the vernal air,
 At once to full perfection grew.

Her slender form, ethereal light,
 Her velvet-textured wings enfold ;
 With all the rainbow's colours bright,
 And dropt with spots of burnish'd gold.

Trembling with joy a while she stood,
 And felt the sun's enlivening ray ;
 Drank from the skies the vital flood,
 And wonder'd at her plumage gay !

And balanc'd oft her broider'd wings,
 Through fields of air prepared to sail ;
 Then on her vent'rous journey springs,
 And floats along the rising gale.

Go, child of pleasure, range the fields,
 Taste all the joys that spring can give,
 Partake what bounteous summer yields,
 And live whilst yet 'tis thine to live.

Go, sip the rose's fragrant dew,
 The lily's honey'd cup explore ;
 From flower to flower the search renew,
 And rifle all the woodbine's store ;

And let me trace thy vagrant flight,
 Thy moments too of short repose,
 And mark thee then with fresh delight,
 Thy golden pinions ope and close.

But, hark ! whilst thus I musing stand,
 Pours on the gale an airy note ;
 And, breathing from a viewless band,
 Soft silv'ry tones around me float !

They cease—but still a voice I hear,
 A whisper'd voice of hope and joy,
 “ *Thy* hour of rest's approaching near,—
 Prepare thee, mortal ! thou must die !

“ Yet, start not !—on thy closing eyes
 Another day shall still unfold,
 A sun of milder radiance rise,
 A happier age of joys untold.

“ Shall the poor worm that shocks thy sight,
 The humblest form in Nature's train,
 Thus rise in new-born lustre bright,
 And yet the emblem teach in vain ?

” Ah ! where were once her golden eyes,
 Her glittering wings of purple pride ?
 Conceal'd beneath a rude disguise,
 A shapeless mass, to earth allied.

“ Like thee the hapless reptile lived,
 Like thee he toil'd, like thee he spun,
 Like thine his closing hour arrived,
 His labour ceased, his web was done.

“ And shalt thou, number'd with the dead,
 No happier state of being know ?
 And shall no future morrow shed
 On thee a beam of brighter glow ?

“Is this the bound of power divine,
To animate an insect frame?
Or shall not He who moulded thine
Wake at his will the vital flame?”

“Go, mortal! in thy reptile state,
Enough to know to thee is given;
Go, and the joyful truth relate;
Frail child of earth! high heir of heaven!”

EMMA.

Thank you, Papa; it is a beautiful poem. It makes me long to hear more about these changes. I really begin to be very much interested in insects.

MR. B.

I am glad, my love, if your interest is excited on a subject which I have myself pursued with so much delight. It will be, I assure you, a gratifying task to give you such a familiar introduction to it, as your Mamma proposes. I think you will find in the history of insects much to amuse and much to instruct you; and that as we go on, you will acknowledge that I have not too warmly recommended a study so replete with interesting wonders.

It is indeed matter of surprise to me, that subjects such as these, which have so direct a tendency to cultivate the taste, and to induce habits of observation, and a fondness for the simple pleasures of nature, are not more generally pursued by young ladies.

SECOND EVENING.

Four states of insects.—Eggs, varieties of form and colour, numbers, enemies.—Parental care of insects, of sand wasps, of earwigs.—Explanation of the term larva, of annulose and articulated animals.—Muscular power of larvæ, head, mouth, voracity, number of feet.—Apod larvæ, their motions; grub of nut weevil; maggot of cheese fly.—Climbing caterpillars; geometicians; processionaries.—Mode of breathing of insects.—Insects are nourished by fluids pervading the body without a circulating system.—Mask of larva of dragon fly.—Larva of ant lion.—Length of time that insects remain in the larva state.

I am under a promise, Emma, said Mr. B., of giving you a little peep into the wonders of the insect world; and if it will be agreeable to you and Mamma, I shall be happy to devote this evening to the subject.

EMMA.

Thank you, Papa. I have been longing rather impatiently for your first leisure evening.

MR. B.

In giving you this peep, it is not my intention

to burden you with any thing that you might consider *dry*. My only object will be to give you such a general and familiar view of the economy of this interesting part of creation, as may bespeak for it your favourable regard; and induce you still further to pursue a study so well calculated to amuse a leisure hour, and to fill up the vacuities of thought with profitable contemplations.

Most insects pass through four distinct states: the egg, the caterpillar, the chrysalis, and the perfect insect; or, to speak scientifically, the egg, the larva, the pupa, and the imago. I am not fond of the pedantry of using scientific words, when those in common use would answer the purpose as well; but as we have no terms in our language that apply to the different states of all insects, it is more convenient, when we speak of them generally, to employ those which have been invented for the purpose.

EMMA.

I suppose then caterpillars, maggots, and grubs, are all called *larvæ*?

MR. B.

Yes: the term larva is applied to all insects

in their second state, and pupa in their third. The words caterpillar, maggot, grub, and chrysalis, nymph, semi-nymph, cased-nymph, &c. definitely pointing out the sort of larva or pupa meant; just as in botany, you know, the common term *pericarp* applies to all seed vessels; while the several kinds are designated by the names capsule, silicle, legume, berry, &c.

To begin then with these little creatures where Nature begins, I must first tell you a little about them in their egg state; though some say that the *egg* ought not to be called a state at all; because the insect does not exist till it is hatched into life. We shall not attempt, however, to settle this question.

The eggs of insects alone would furnish materials for an interesting little volume.

One peculiarity in them is the great variety of their forms. The eggs of birds are, as you know, nearly all of the same shape; but those of insects present almost every conceivable variety of outline, as well as of ornament and colour.

I have put a few into the microscope. This is the egg of a nettle butterfly.*

* Plate I. Fig. 12.

EMMA.

How curious ! it looks like a little melon.

MR. B.

And this is one of a cabbage butterfly.*

EMMA.

O that is prettier still ; it is in the shape of an oil-flask, and looks as if it were made of fine Indian wicker-work. How exactly and delicately all the longitudinal ridges are connected by lines crossing them !

MR. B.

This is a gnat's egg† ; can you find a comparison for it ?

EMMA.

The form is extremely elegant ; I think it is like some antique vase I have seen.

MR. B.

The variety of colours is also remarkable. Most are white when first laid ; but after a little exposure to the air, some turn red, others green, blue, orange, or black. Some too are beautifully speckled and others are striped. This gnat's egg, you observe, already looks greenish ; it will soon become entirely green, and at length, before hatching will turn grey.

* Plate I. Fig. 13. † Plate I. Fig. 4.

Another peculiarity in the eggs of insects is the great number usually deposited. In this, however, different species vary considerably. There is one kind of fly that lays only two eggs; and there are other flies that lay only six or eight. The flea lays twelve; and the burying beetle thirty. There are exceptions to the remark. Of other insects the number varies from one hundred eggs to two hundred thousand and even more. The silk-worm moth lays, I believe, five hundred; the great goat moth, a thousand; the tiger moth, sixteen hundred; the female wasp, at least thirty thousand; and the queen bee sometimes forty or fifty thousand. With the exception of fishes, insects exceed in fecundity all other orders of animals.

EMMA.

It seems then unaccountable that they are not still more numerous than we find them to be.

MR. B.

They have various enemies in every stage of their progress from the egg to the mature state. The unhatched eggs often fall a prey to the larvæ first extruded; and of those that are hatched, vast numbers are destroyed by birds, and other insectivorous creatures. It has been calculated

that a single pair of sparrows, having young ones to maintain, will destroy more than three thousand caterpillars in a week. They have also foes among their own class; of which the most remarkable are the little four winged flies, called by Linnæus *ichneumons*, from the resemblance of their proceedings with caterpillars to the fabled proceedings of the Egyptian ichneumon with the crocodile. These little enemies, some of which are scarcely so big as ants, do the work of destruction among the larvæ of different insects far more efficiently than could be done by any human means.

One of these minute murderers has been seen to perch on the back of an unwary caterpillar, and gently piercing the insect's skin in various places, to deposit as many as thirty eggs. The grubs of these eggs, when hatched, feed on the body of the caterpillar; and when full grown, eat their way out, leaving their victim to die.

Another interesting subject of remark in connection with the eggs of insects, is the care exhibited by the parent for their protection.

Some, as the various species of spiders, and one family of water-beetles, spin a silken pouch in which to enclose them; others smear them over

with varnish ; and many, whose eggs are tender, or have to resist the wet and cold of winter, defend them in a most skilful manner with a covering of different kinds of substance : I have read of one species of moth, of which the mother actually makes a shelter for them of hair stripped from her own body. She first forms a soft couch of this hair on the surface of some leaf ; she then places upon it successive layers of eggs, and surrounds them with a similar downy covering ; and when the whole number is deposited, covers the surface with a roofing of hairs. Those used for the interior are placed without order ; but those employed externally are arranged with as much skill as the tiles on a house, and as effectually keep out the water ; one layer resting partly on the other, and all having the same direction, so that the whole resembles a well-brushed piece of fur.

Several insects make leaves, and other parts of plants serve as coverings for their eggs. Some of the saw-flies, for instance, make an incision with their saws in the green twigs of a shrub or tree, and fill it with a line of eggs placed end to end, taking care to leave room for the growth of the eggs.

Mrs. B.

What instinctive skill! But I was not aware that the eggs of insects grow.

Mr. B.

Some do; particularly those of the saw-flies, the gall-flies, and the ants. They usually increase to double their original size before they are hatched.

EMMA.

Do all insects cover their eggs?

Mr. B.

No, not all. The only care of some is to place them upon or near the food appropriated to the young larvæ. This is never neglected; for there are no improvident parents in the insect world. Most butterflies and moths attach their eggs to the stems, twigs, and leaves, or embryo fruits of trees or plants. The lady-birds and some others deposit theirs in the midst of plant lice; the flesh-flies generally gum theirs upon flesh; the house-fly lays hers in horse-dung; those of crickets and grasshoppers are buried in the earth; and those of the gnat are set afloat upon the water; two or three hundred of them being glued together, side by side, so as very much to resemble in shape a little life-boat.

Mrs. B.

I believe few insects neglect order in the disposal of their eggs.

Mr. B.

No: "Order is Heaven's first law," and it prevails in all the unfallen parts of God's creation. Sometimes, it is true, the eggs are placed in what appears a confused mass; but in most instances they are arranged in various, and frequently in very beautiful modes. The common cabbage butterfly, and many others, place them upon one end, side by side, like a close column of soldiers; the eggs of the emperor moth are piled in two or more lines like bottles of wine in a bin; and the lackey moth, whose eggs you may often find in winter, surrounding the twigs of fruit-trees, arranges them in numerous circles with such admirable art, that you would take them rather for pearls, set by the hand of a jeweller, than for the eggs of an insect. The French gardeners call them *bracelets*.

Some insects deposit their eggs singly; but still with the same attention to the safety of the egg, and the future wants of the offspring. The nut and the acorn-weevil pierce a nut or an acorn while soft, with their long beak, and then deposit

in the hole an egg, the maggot of which is supplied by the kernel with appropriate food.

EMMA.

I have often found plums and other fruits maggoty. I suppose the egg was laid in the fruit by the parent insect.

MR. B.

Yes: the eggs are often glued to the embryo fruit, even before the petals fall off; so that the caterpillars, on being disclosed, find themselves on a tender germ, which they easily pierce, and into the interior of which they can without difficulty introduce themselves. It is remarkable that the peach and the apricot are entirely free from such intrusions.

But the most singular labour of the parent insect, in making provision for its offspring, is that of the sand wasps. It was first noticed by Ray, one of our earliest entomologists, nearly two hundred years ago, and has been frequently verified since. There are several species of these insects, but the proceedings of them all are similar. They first dig in the sand or earth a cylindrical cavity of the requisite dimensions, and having deposited an egg at the bottom, enclose

along with it one or more caterpillars, spiders, or other insects, as a provision for the young when hatched, and sufficiently abundant to nourish it till it becomes a pupa. These victims are put in alive; and if, as is not unfrequently the case, they attempt to defend themselves, a few stings effectually deprive them of all power of resistance.

The mason wasps do nearly the same. They bury with the egg eight or nine small green caterpillars, selecting such as having attained their full size, will themselves require no more food. To prevent the possibility of injury to the egg, they coil the caterpillars one above another in a series of rings, and consolidate the earth so firmly around them, that they have not the slightest power of resistance. In this position the poor captives remain confined, till the grub of the wasp, awaking to life, devours them.

But I am entering on an almost endless subject; for every different species of insect has some plan, peculiar to its kind, of making provision for its offspring; though, in most cases, that offspring it will never live to see. As I before remarked, there is no insect that “provides not for its own.”

MRS. B.

It would be well if some parents among mankind would take a lesson from them.

MR. B.

It would indeed.

EMMA.

Are the eggs in general long in hatching?

MR. B.

They vary very much in the time requisite for that purpose; some require only a few hours, others, several months. Much of course depends on the temperature of the atmosphere.

The eggs of many flesh-flies are hatched in our climate in twenty-four hours; those of bees in three days; while those of beetles, and indeed of some butterflies too, require from one to nine months. The eggs of most insects laid in autumn remain unhatched till the following spring.

EMMA.

I suppose no insects hatch their own eggs as birds do.

MR. B.

Not exactly as birds do, certainly; for as insects generally have no vital heat, they cannot impart any. There are one or two, however,

that have been observed to brood over their eggs and their young ones too. One insect to which I believe you have a peculiar aversion does this.

EMMA.

O Papa! never refer again, if you please, to my silly prejudices. I am quite ashamed of them.

MR. B.

Then I may venture to introduce to you a female earwig, as an insect that very nearly approaches the habits of the anxious hen in her care of her family. She absolutely sits upon her eggs, as if to hatch them; and when they are hatched, broods over her young ones with the greatest tenderness, suffering them to creep under her and to push between her feet, just as chickens do under a hen.

EMMA.

I should much like to see it for myself.

MR. B.

You seem a little sceptical on the subject; but I can assure you it has been repeatedly observed. Should you ever be so diligent an entomologist as to turn up stones embedded in the earth to discover the inhabitants that may be under them, you will, in all probability, at some time be gratified by the sight of a mother earwig thus brooding over a cluster of young ones.

Here comes Frederick. I hope he has been successful in his search. I requested him to go this afternoon into the shrubbery and gardens, or wherever he thought he should be most likely to succeed, to find for us as many caterpillars and grubs as he could; for it is always best, where it is practicable, to have the living insect before us.

FREDERICK.

Well, Father: I think you will say that I have executed your commission with some success. Here are caterpillars, grubs, and maggots of various sorts and sizes. Thomas went with me, and having provided ourselves with a large cloth which we fixed underneath the boughs and as close to them as we could, we brushed nearly every shrub and tree in the grounds and in the neighbouring copse; and I can assure you we have literally left no stone unturned.

MR. B.

We are all much obliged by your diligent exertions. You have indeed brought a variety of larvæ, and I am glad to see that you have put into the box with each a supply of its appropriate food.

EMMA.

I never saw such a collection of caterpillars and grubs before!

Mrs. B.

Do you not admire their beauty and variety? There are scarcely two at all alike. Some are all of one colour, others are of different colours, very bright and gaily contrasted; some are marked in longitudinal stripes; some, in bands; and some, in waves. Some again have a soft smooth skin; others have it rough, almost like shagreen; and others have as beautiful a coat of hair as our tortoise-shell cat.

Mr. B.

One colour, so far as utility to the insect is concerned, would probably be as good as another. The only assignable reason for such a variety therefore, appears to be our gratification. And thus it is in every department of nature; wherever we look, we find the beautiful as well as the useful; that which is pleasant to the sight, as well as that which is necessary to the purposes of creation. It is remarkable that the colours of caterpillars, with few exceptions, are very different indeed from those of the insects into which they are transformed. Plain and inconspicuous caterpillars will sometimes give splendidly coloured flies; while finely marked caterpillars will give plain ones. This caterpillar, (*Bombyx Neustria*) for instance,

whose gaudy stripes of blue, white, and red, have obtained for it the name of *lackey*, will disclose a yellowish moth, with stripes on the wings of yellow brown.

EMMA.

The caterpillars are certainly very pretty ; but do not you think, Mamma, that some of the grubs are disgusting looking creatures ?

MRS. B.

I do not call them *disgusting*, Emma. Nothing deserves to be so called that keeps the place, and fulfils the purpose, for which providence designed it. Their naked, unadorned appearance is not perhaps inviting ; but you should remember that they have been brought from their hiding places under the turf or stones ; and that they were not intended to meet the human eye till, on attaining their perfect state, they assumed their beautiful covering.

MR. B.

You understand, Emma, that these are insects in their second or *larva* state. But I ought to explain to you that *larva* is a Latin word signifying a mask ; and that it was adopted by Linnè, because the insect, such as it afterwards appears, lies masked as it were, or concealed, under this external form.

EMMA.

Do you mean to say, Papa, that a butterfly lies concealed in this caterpillar ?

MR. B.

Yes, my dear. The butterfly, with its organs indeed in an almost fluid state, but still perfect in all its parts, lies encased within the caterpillar. Of this fact it would be easy to convince you, by boiling a full grown caterpillar for a few minutes, or by laying it for a few days in vinegar or spirits of wine, for the purpose of giving consistency to its parts; a very rough dissection would then discover to you the future butterfly. Its wings you would see rolled up into a sort of cord, and lodged between the first and second segment of the body; the antennæ and trunk, coiled up in front of the head; and the legs, however different in form, actually sheathed in the present legs of the insect.

You observe that instead of an internal skeleton, the covering of the body in these larvæ is divided into a certain number of rings jointed together. On this account, insects are sometimes called *annulose* animals, from *annulus*, a ring; and sometimes *articulated* animals, from *articulus*, a joint.

These rings are united by bands of muscles, which enable them to bend the body with ease, in any direction, as you see they all can do.

Mrs. B.

The muscular power of caterpillars must be very great. I have frequently observed them fixed by their hind legs only, to a branch, and looking like a little twig of it, and in that position sustaining themselves for a considerable time without the least motion.*

Mr. B.

The number of muscles which their bodies contain is immense. Lyonet counted those in the body of the caterpillar of the great goat moth, (*Cossus Ligniperda*) and found altogether four thousand and sixty-one. In the human subject, I believe, not more than five hundred and twenty-nine have been counted; so that this minute animal has three thousand five hundred and thirty-two muscles more than a man.

The various attitudes they assume, are indeed a sufficient proof of the number and strength of their muscles.

Let us look for a minute at the heads of these larvæ. They are, you observe, of a horny sub-

* Plate I. Fig. 2.

stance, and are all naked, whatever may be the covering of the other parts of the body.

EMMA.

And where not of the same colour as the body, they seem to be all of a reddish brown.

MR. B.

That is the most usual colour of the head.

FREDERICK.

Have insects in the larva state the sense of sight?

MR. B.

Many have not; but a still greater number have. With few exceptions, however, the eyes are simple, and do not present the same complexity of structure as in the perfect insect. Most caterpillars have twelve such eyes, but so minute that they are nearly invisible without the aid of a microscope. They have also, most of them at least, that beautiful appendage to the head of the perfect insect, antennæ: though generally speaking, of a much smaller and plainer form.

EMMA.

It is unnecessary to ask whether they have mouths: how rapaciously most of them are devouring the leaves!

Mrs. B.

O yes: they have all mouths, and mouths well furnished with implements of destruction. Most of them have something analogous to jaws and teeth, of a hard horny substance, and moved by powerful muscles. The jaws of a caterpillar do not act perpendicularly, as ours do, but horizontally, or from side to side. Generally speaking, they are slightly bent, something in the form of a reaping hook, and are made to meet like the blades of a pair of pincers. Altogether they are a formidable apparatus, well adapted to their purpose.

EMMA.

Only look, Frederick, this caterpillar has nearly consumed this large leaf already!

Mr. B.

A caterpillar may be compared to an Indian hunter; it issues from the egg, as he does from his hut, with a keen appetite. The quantity larvæ eat is astonishing. A cabbage caterpillar will consume more than twice its own weight in twenty-four hours; and the maggots of many flesh flies will in a night and day, devour so much as to increase their weight two hundred fold.

MRS. B.

I think I have read that a silk worm consumes within thirty days, about sixty thousand times its original weight.

MR. B.

The weight of the silk worm at first, is to be sure, very minute, and its growth rapid ; so that it is difficult to institute a comparison between it and other creatures ; but it appears a prodigious consumption. A human being in health would require I suppose in the same time, about once his own weight of solid and liquid aliment.

FREDERICK.

Did not Linnè say that the larvæ of three blue-bottle flies would consume the carcass of a horse as quickly as a lion would ?

MR. B.

Yes : and I do not think it is an exaggerated description of their voracity. Some flies of that species produce twenty thousand larvæ. Sixty thousand of these insects, each consuming in twenty-four hours two hundred times its own weight, would do something towards demolishing even a larger carcass.

It appears indispensable for most insects, in

this stage of their existence, to feed copiously, in order to supply a store of nutriment for their future changes ; and their intestines are almost all stomach for receiving and digesting the masses of food they consume ; but when they attain their perfect state, the stomach is reduced to a thread, and many of them eat nothing at all.

EMMA.

What a number of legs the caterpillars have !

MR. B.

None of them have more than six proper legs, which are placed in three pairs near the head. The other little processes which you take for legs, are merely tubercles, or false feet, which serve to support the length of the body, and sometimes act as cramps in walking ; but, generally speaking, they have no joints, and consequently no free motion.

It is only the caterpillars, you observe, that have these *prolegs*, as they are called. These grubs of beetles, you see, have only the six proper legs ; and the grubs and maggots of many other kinds of insects have no legs at all. Those larvæ that have legs are called *pedate* larvæ, or larvæ with feet ; those that have none, *apod* larvæ, or larvæ without feet.

You must not, however, suppose that those without feet are therefore incapable of motion. In general, their mode of life makes a frequent change of place less necessary to them than it is to the pedate larvæ; but, I assure you, they can move when occasion requires it, and some of them very nimbly too: some walk, others jump, and others swim, notwithstanding their want of limbs.

EMMA.

I suppose the grubs we meet with in nuts are among the walkers. I have often wondered how they manage to move so fast without feet.

MR. B.

The grub of the nut-weevil is a good specimen of them. It walks by the alternate contraction and extension of the segments of the body; assisted, perhaps, by the fleshy protuberances of its sides; and the maggots of the cheese-fly, commonly called *hoppers*, which revel in our richest cheeses, afford an example of the jumpers. They effect their tremendous leaps, for truly they are so when compared with their size, nearly as salmon are said to pass over cataracts, by taking the tail in the mouth, and then suddenly letting

it go. Swammerdam saw one, whose length did not exceed the fourth part of an inch, jump thus out of a box, six inches in depth; which is equal to a leap of a hundred and forty-four feet to a man six feet high.

MRS. B.

Swammerdam was a great admirer of this little maggot. He speaks, I remember, in high terms of its elegance, and of the art and design displayed in its formation, as conveying a strong proof that it is the production of infinite power and wisdom.

MR. B.

I quite agree with him. Only think how wonderful must be the muscular structure that enables it to exert such activity!

EMMA.

You say, Papa, that some larvæ swim—are there any insects in the sea?

MR. B.

No: there are no insects inhabiting the *sea*; but many pass the first stage of their existence in fresh water. You remember the little boat of eggs which the gnat entrusts to the watery element; and there are many others, the dragon

flies, for example, that begin their existence in water; where, by feeding on the impurities of stagnant ditches and pools, they render us services of incalculable value: preventing by their vigilance, putrid exhalations which might produce fatal disorders.

I have here in a tumbler, as a specimen of the swimmers, a few grubs of the common gnat. During this hot summer weather they may be met with in abundance in ditches and waterbutts, or any stagnant water.

EMMA.

They look something like little, transparent, whitish shrimps or fishes.

MR. B.

If disposed to descend, you observe, they appear to sink by the weight of the body: but when they would rise again, it is done by alternate contortions of the upper and lower halves of it. They thus swim with much celerity.

It would take long to enumerate all the different motions observable in insects, even in their larva state; in the pedate larvæ especially; some are remarkable for the slowness of their pace; others run with extreme swiftness; some jump, and others swim. But I cannot dismiss the subject

without mentioning one species of motion peculiar to them;—I mean their mode of climbing. I will put this cabbage-caterpillar on a pane of glass, and he will show you their plan. Do you not perceive that he has left a visible track behind him? Apply the magnifying glass, and you will see that that track consists of little silken threads, spun in a zigzag manner, and forming a sort of rope-ladder, by which he ascends a surface he could not otherwise adhere to. The silk, as it proceeds from the caterpillar, is a gummy fluid which hardens in the air; so that the insect has no difficulty in making it stick to the glass.

Many caterpillars that feed upon trees, use ropes instead of ladders; particularly the *Geometricians*, as they are called. I am glad to find that Frederick has brought us specimens of them. As these insects have frequent occasion to descend from branch to branch, and sometimes to the ground, if they were obliged to traverse the rugged trunk, their journeys would be tedious and fatiguing; but by means of a silken cord which they can let down from their own internal stores to any length, they can descend conveniently

and expeditiously, travel where they please, and when they wish to return, can find their way back to the leaf they had left. Thus they can drop themselves from the most lofty trees ; and by gathering in, as they go home, the thread they spun on their way out, can ascend again with great facility.

EMMA.

I have often seen them hanging by their little threads ; there is one tree in the garden at school famous for them ; but we always avoid going under it, for fear they should fall upon us.— In future I shall look at them with different feelings.

FREDERICK.

Just like young ladies at school !

MR. B.

You see then one of the advantages of science ; it sometimes gives even an attractive charm to that which otherwise would be an object of disgust. Many caterpillars, however, drop themselves in this manner besides those properly called Geometricians.

EMMA.

Why are they called Geometricians ?

MR. B.

Because they seem to imitate geometricians by measuring the surface they pass over as if with a chain. Place this on your hand, and you will find that it draws a thread as it goes; when it moves, its head is extended as far as it can reach with it; then, fastening the thread there, it brings up the rest of its body, and takes another step; never moving without leaving this clue behind it.

MRS. B.

The *Processionary* caterpillars are the most amusing to me in their movements. I remember once, as we were travelling, stopping at a plantation of pine-trees to observe some; and very interesting it was to see them all issuing from their tent in company, and maintaining as exact an order in their march as a regiment of soldiers. They defiled one by one with an equal and rather slow step, the head of the caterpillar which followed, touching the tail of its predecessor. Sometimes they went in a straight line; sometimes they described a variety of curves, resembling beautiful festoons or garlands. Their path they carpeted with a silken tapestry of a

lustrous white, nearly a quarter of an inch in breadth. Indeed, they appeared unable to walk but on this silken carpet;—for a young friend who was with me, was mischievous enough to draw her finger across the path, so as to tear out a piece of it, by which the poor little travellers seemed to be thrown into the greatest embarrassment. They all suddenly stopped, and the march appeared suspended, until one, bolder or more impatient than the rest, dared to cross the gap. The thread it spun in crossing, became a bridge for another; and each one, as it successively passed, contributing its thread, the path was soon repaired.

MR. B.

There is another species of gregarious caterpillar that inhabit oak trees, though not found in our country, which are more particularly called Processionaries. During the heat of the day they usually repose, seven or eight hundred of them together, in their common habitation; but when the evening hour of repast arrives, they quit the nest in procession, and may be seen traversing the distance from one tree to another, in search of food. A single caterpillar

opens the march, the others follow in file, and sometimes two, three, or four abreast. Such perfect order is observed among them that the head of one never passes that of another. When they find a branch covered with fresh leaves, they spread themselves over it, still remaining close to each other; and when they have terminated their repast, they march back to their nest in the original order, the same caterpillar still taking the lead.

EMMA.

How pretty it must be to see them!

What are these little dots or spots along the sides of the caterpillars? I see they all have them, and the grubs too. Through the magnifying glass they have a very curious appearance.

MR. B.

I am glad you have asked the question. They are called *spiracles*, and are the little apertures through which the insect breathes.

EMMA.

Indeed!

MR. B.

Insects in all their states breathe through these spiracles, or something analogous to them, and

in most, they are placed along the sides. Some larvæ that are intended to feed on flesh or dung, or other adhesive food, have instead respiratory plates, two at the head and two at the tail, and so arranged as to secure them from being stopped up by any unctuous matter; and the larvæ of gnats and other aquatic insects have a curious breathing apparatus near the tail. You see these all have their tails at the surface of the water. Spiders also are an exception; they have gills instead of spiracles.

The discoveries of modern science have satisfactorily proved that the physiology of insects differs in many essential particulars from that of the higher orders of animals. It was once supposed that

—————“each within its little bulk contains

A heart that drives the torrent through the veins;”

but it is now clearly ascertained that as the minute structures and short-lived existence of insects do not require so complicated an apparatus of life as is needed by creatures of larger size and longer duration, they have neither veins nor heart, and consequently no “torrent” passing through them: and that they are nourished by fluids pervading

every part of the body without circulation ; while, as I have just said, they receive air by apertures conveniently placed along the sides.

FREDERICK.

I went down to the river to see if I could find the larva of a dragon fly, that Emma might be entertained with a sight of its curious mask ; but I am sorry to say, I did not succeed.

MRS. B.

I have in my portfolio a sketch of one, from which, with Papa's assistance, she will form a very good idea of it.—Here it is.

MR. B.

This is a very correct delineation of one of these murderous insects. The mask* is represented as applied close to and covering the face : it does so while the insect is at rest, or waiting for prey ; but no sooner does the unwary victim approach, than the ferocious little animal first opens the upper part of it, which is formed of two jaw-like plates ; then, having by means of [a joint at the chin, let down the whole visor, and uncovered the face, it catches up the prey by means of these plates, which it uses as arms, and conveys

* Plate II. Fig. 1.

it to its mouth. Reaumur once found one of them thus holding and devouring a large tadpole.

EMMA.

What a giant Grim !

FREDERICK.

I was unexpectedly successful in capturing another larva, belonging, I believe, to the same order as the dragon-fly, and one that equally deserves the name of *giant Grim*. As I passed by the southern wall of the old castle, I spied a hole in the sand-bank; seeing two horns peeping out, I guessed at the tenant, and seized the giant in his lurking place. I have him here in a box filled with sand.

MR. B.

An ant-lion, have you ! You have indeed been very successful this evening.

EMMA.

I am glad of that. I have often read of the cunning contrivances of the ant-lion ; but I have no idea what sort of a creature it is.

MR. B.

We will open the box, and you shall see.* You observe that it is of a greyish colour ; and

* Plate I. Fig. 3.

that it has six feet, and a body remarkably thick, in proportion to the corslet and head. The head, you see, is very small, and is armed with two horns, which answer the purpose of pincers and suckers.

EMMA.

How very slender the legs are in comparison with the body!

MR. B.

It could not catch its prey by running, as you will easily believe; for it cannot run at all; and when it walks, it walks backwards, and very slowly; it therefore has recourse to stratagem. Forming in a dry sandy situation a funnel-shaped hollow of suitable dimensions, it hides itself in ambush at the bottom, projecting only its horns, ready to seize its unwary prey. Woe to any imprudent insect, the ant especially, that in proceeding on its way, dares to approach this cavern. On coming near the edge, it inevitably slides into the pit; or if it keep at a cautious distance, the lurking enemy, as soon as he sees it, showers upon it with his head, which he uses as a shovel, such a quantity of sand that the ant becomes completely stunned; and, tumbling

to the bottom of the hole, is seized between the murderous pincers of the foe, and dragged under the sand, to be sucked to death at leisure. Having drawn from it all that is nutritive, the ant-lion places the dried carcass upon its head and legs, and by a sudden jerk, casts it beyond the outer circle of this pitfall.

EMMA.

What a horrid little murderer! But its history is interesting.

MR. B.

Unlike most other insects in this respect, the ant-lion is far more interesting in its larva than in its mature state. When it arrives at maturity, and assumes its elegant form and light gauze wings, forgetting all its carnivorous propensities, it gaily sallies forth, chiefly in the evening, to revel on the honeyed juices of fruits and flowers; and its life is henceforth a perpetual feast of ambrosial sweets.

FREDERICK.

How long do insects usually remain in the larva state?

MR. B.

The length of time varies considerably; but it is, in all cases, nicely adapted to their several

functions and modes of life. The grubs of the flesh-fly have attained their full size and are ready to become pupæ in six or seven days ; the larvæ of bees in twenty days ; while those of the great goat moth and cock-chafer live three years before their changes. Some live even longer than this : the wire worm, which is one of the great enemies of the farmer, and is the larva of a species of beetle, remains in this state five years ; and the stag beetle is said to remain in it for even six years. With few exceptions it is found that those larvæ which live on dead animals, in fungi, in dung, and in similar substances, are of the shortest duration in this state ; and those that live under the earth on the roots of grass and plants, or in wood, the longest : the former becoming pupæ in a few days or weeks, the latter, requiring several months or even years to bring them to maturity. Those which live on the leaves of plants, seem to have a middle term between the one and the other.*

But it is almost time to say good night. Should nothing prevent, I hope to-morrow evening to resume the subject, and to give you a few particulars of insects in their pupa state.

* Kirby.

THIRD EVENING.

Mode of obtaining pupæ; breeding cage for insects.—

Moulting of larvæ.—Preparations for assuming the pupa; silk employed by numerous insects.—Explanation of the term pupa; chrysalis, nymph, cased-nymph, semi-nymph, complete pupa.—Length of time that insects remain in the pupa state.—Many have a fixed hour for disclosing the perfect insect; the silkworm, hawk-moth, ephemeræ.

I have endeavoured, Father, said Frederick as he entered, to be present at the commencement of your lecture this evening; for if you will allow me, I shall much like to share with Emma, in the instructions you have engaged to give her.

Supposing that the contribution of a few specimens would again be acceptable, I have been hunting in every hollow tree and over every piece of wall and paling to find you a few pupæ; but I have met with only two.

I have found however a very curious caterpillar, it seems covered over with little yellow silken balls.

MR. B.

This is a caterpillar, Emma, which has been destroyed as I described to you, by an ichneumon fly; these little yellow balls are cocoons, which the grubs that fed on the body of the insect, formed for themselves, on eating their way out of it.

To obtain pupæ, the best way is to dig for them under the spreading branches of trees, or under turf: but it is almost too early yet; they are found most abundantly at the end of July, or the beginning of August; and some species in January and February. Another good plan is to take the insects in their larva state, and provide them with such accommodation as their habits require.

Mr. F. who is, you know, a very curious observer of insects, has a box, about two feet long, twelve inches high, and six broad, divided into six compartments. The lower half is constructed entirely of wood, and the upper, of coarse gauze stretched upon wood or wire frames. Each compartment has a separate door, and is filled to the height of six inches, with a mixture

of fine earth, and the dust from the inside of rotten trees ; it is moreover furnished with a phial in the centre for the purpose of containing water, in which the food is kept fresh ; and on the surface of the mould he places a thick layer of moss, which he saturates with water, as often as is needful, for the purpose of preserving a sufficient degree of moisture. Into the different compartments of this cage, he puts any caterpillars or grubs he may find, taking care to keep each supplied with its appropriate food in a fresh state. By this means he has been successful in making valuable observations on the habits and changes of various insects.

I would advise you to procure such a box, if you wish to become a good practical entomologist.

FREDERICK.

I suppose the rotten wood is for the use of such larvæ as construct their cocoons of that substance.

MR. B.

Yes : and to make the soil less binding upon others.

I purposely omitted last evening one curious particular relating to larvæ, because it is intimately connected with the change to the pupa state : I mean their moulting or change of skin.

A change in the exterior covering of the body takes place, as you know in other animals. Quad-rupeds renew their hair, and birds their feathers ; and even in the human species there is a gradual scaling off and renewal of the outer skin ; but in insects the whole outer skin is thrown off altogether, like an old garment that is out grown.

The opinion of Swammerdam was, and it appears to be correct, that the larva includes a series of cases or envelopes one within the other, containing in the centre the germ of the future perfect insect, whose developement and final exclusion take place only when these cases have been successively thrown off. Each skin is perfectly formed from the first: in hairy caterpillars each has even the little tufts of hair lying in order something like so many minute hair pencils : and within these successive coverings, is the envelope which covers the insect in the pupa state.

Different insects vary in the number of these skins. The silkworm has four.

FREDERICK.

I remember to have observed when I once kept silk worms that the first skin was cast at about twelve days from the birth ; and the remaining

three, each at the end of about six days from the moulting that preceded it.

MR. B.

I am glad that you made such accurate observations.

Most caterpillars have four changes of skin : but some have only three, and there are some few that have a much greater number ; some moult five, six, seven, and even ten times. Now only think of such a number of skins, not produced from time to time, as is the case with serpents, from the integument of the body, but lying one within the other, each separately and perfectly formed from the first, and provided with its various appendages for ornament or defence.

MRS. B.

And not only is the body provided with this succession of coverings, but the head, the eyes, the antennæ, and even the jaws, have, I believe, the same provision for change. I have seen the whole covering of the insect cast so entire, that it might be mistaken for the larva itself ; there were the very skull, eyes, antennæ, palpi, jaws, legs,—all hollow and empty.

EMMA.

I should think it must be painful to the insect to undergo so entire a change of skin.

MR. B.

There is no doubt that it is; and not unfrequently fatal too. A day or two previous to each moult, the larva ceases eating altogether; it becomes languid and feeble; its beautiful colours fade; and it seeks for a safe retreat in which to undergo the operation. When it is over, the little creature is at first extremely weak; and it is not until after some hours, and, in some cases, even days, during which it lies without motion, that all its parts become consolidated, and it recovers sufficient strength to betake itself to its accustomed food; but when a few meals have invigorated its languid powers, the renovated insect makes up for its long abstinence by eating with double voracity.*

FREDERICK.

Do all larvæ undergo these changes?

MR. B.

There are some exceptions. The maggot of the common flesh-fly never changes its skin;

* Kirby.

and the grubs of bees, wasps, and ants, do not change it till they assume the pupa.

When the last time of casting the skin arrives, and the pupa is about to be disclosed, the insect quits the plant or tree, on which it had lived, and appears quite unsettled. You may often see one in this condition wandering about, and crossing the paths and roads, as if in quest of some new dwelling. The little creature has done with its former food and its former habits, and is preparing to enter a new stage of existence.

Some that feed under ground, or in the interior of trees, fruits, and seeds, such as beetles, bees, wasps, and some species of flies, merely rest in a state of inactivity in the midst of the substances which have supplied their nutriment. But a far greater number, when about to exchange their state of vigour and activity for the long period of death-like repose, exhibit the greatest anxiety about the choice of a safe retreat. Many, after wandering about, as if bewildered, retire to any small hole on the surface of the earth, and cover themselves with dead leaves or moss; or into the chinks of trees, or niches in walls, and other buildings. Others provide themselves with a grave, or rather a vault under ground, which they

excavate by pushing away the surrounding earth, and the walls of which they render firm by means of a viscid fluid, poured from the mouth. The larva of the death's head moth (*Sphinx Atropos*) thus inters itself at a depth of more than a foot from the surface.

Having reached their selected retreat, many employ no other precaution. Some, however, as the lady-birds and tortoise-beetles, gum themselves by the tail to the leaves or twigs, which they have chosen as a place of concealment. Many of the butterflies suspend themselves by silken cords, in a manner that would baffle the utmost effort of human ingenuity to contrive; and a great number wholly enclose themselves in cases or cocoons, composed of silk and various other materials.

EMMA.

Do any insects besides silk-worms spin silken coverings?

MR. B.

Yes: many. For though Nature, when, as Milton speaks, she

———“Set to work millions of spinning worms,
That in their green shops weave the smooth-hair'd silk,
To deck her sons,”

gave to silk-worms, if I may so express it, the monopoly of this manufacture, yet she did not confine the power of producing silk to them, but conferred it, in inferior degrees, on various other insects. Most of the bee and ant tribes, some of the weevils and beetles, the ant-lions and others, fabricate for themselves silken cocoons. Even when other materials, such as leaves, decayed wood, sand, &c. are employed, silk is usually the cement that unites them together.

FREDERICK.

I remember you once showed me the cocoon of an ant-lion; it was round, and externally composed of grains of sand, cemented with silk; the interior was lined with silk of a satiny white, just fit to be the abode of the elegant insect that emerged from it.

MRS. B.

I have a drawing of the cocoon of a species of moth, one of the *phalenæ*, which I think remarkably elegant. It is composed of leaves and flowers tied together with silk, and is suspended to a twig by layers of silken threads.*

* Plate II. Fig. 2.

MR. B.

The phalenæ are our little geometrical acquaintance. Many of them are industrious spinners, and very elegant in their habits.

The most extensive silk manufacturers, however, are the various species of *Bombyx*. The *Bombyx proper* is the common silk-worm, (*Bombyx Mori*;) but there are several nearly allied genera in our own country, whose strong white webs you must have observed upon the hedges and fruit trees, covering hundreds of caterpillars. Of these the webs of the *Bombyx Chrysorrhæa* are the most common.

EMMA.

O! I have seen them; but I always thought they were spiders' webs, which caterpillars had crept into.

MR. B.

I do not suppose you ever *thought* much about the matter; or you would have thought how very different they are from spiders' webs in form and substance too.

FREDERICK.

The lackey caterpillar, which I brought you yesterday, I took from among a large party that

were regaling themselves under such silken tent upon the leaves of an apple-tree.

MR. B.

The webs of the lackey caterpillars (*Bombyx Neustria*) are frequently to be found on the fruit trees, and hedges too, for nothing comes amiss to them.

The caterpillars inhabiting pine-trees, (*Bombyx Abietis*,) which your Mamma was describing yesterday as marching in such order, and carpeting their paths so curiously, dwell also together under an ample web or tent, formed of a strong kind of white silk.

Wherever indeed you see a thick web on the trees, the grass, or the hedges, you may be pretty sure to find that there is or has been under it a colony of caterpillars. Some remain under the web only for a time, and separate before the period of metamorphosis arrives, each to live in solitude; others remain in society through all their changes, and do not leave each other till they have attained maturity.

EMMA.

Are their productions of any use to us?

MR. B.

We are not to estimate their *use* merely by their value to us. God cares for the wants of the insect, my dear Emma, as well as for those of the man. That we have not yet found a use for these webs is no proof that they might not be made of of service to us. I am inclined to think that some of these productions might, if cultivated, be employed to advantage. The *Bombyx Abietis* forms a silken cocoon which could, it is believed, be manufactured, if proper pains were taken in preparing it. There is a species of these insects in Madagascar, whose silk is employed by the inhabitants.

Well, after this digression on silk, let us return to the principal object for which it is produced by the insect,—the preparing of a secure retreat in which to pass through its greatest change.

The insect forms the cocoon, you understand, while still in the larva state. Having done this, or made such other provision for security as instinct has dictated, after a time, the skin once more separates, and discloses an oblong body, which Linné called a *pupa*, from its resemblance in miniature to a child trussed up like a mummy,

in swaddling bands, as young infants are in many parts of the continent:—*pupa* is the latin word for baby. In this state most insects require no food, and exhibit no other sign of life even when touched, than that of a slight movement of the abdomen. If opened, they seem filled with a watery fluid, in which no distinct organs can be traced.

The pupæ of different orders and species vary considerably; and different names, as I have already told you, have been applied to them. “Those of the beetle and bee tribes are covered with a membranous skin, inclosing in separate and distinct sheaths the antennæ, legs, and wings, which are consequently not closely applied to the body, but have their form for the most part clearly distinguishable: these are called *nymphs*.

Butterflies, moths, and some of the two-winged insects, are also inclosed in a similar membranous envelope; but their legs, antennæ, and wings, are so closely folded over the breast and sides, that they bear a strong resemblance to the mummies of ancient Egypt; and the whole body is inclosed in a case or covering of a horny consistence, which admits a much less distinct view of the organs beneath it. To these the name of *chrysalis* is given.

FREDERICK.

The two pupæ that I have found are of that description.

MR. B.

Let us see them. This, which is of a greenish yellow, marked with spots of black, is the chrysalis of a cabbage butterfly ; and this, which I should think you found not far from a bed of nettles, is that of a nettle or tortoise-shell butterfly. Only see, Emma, it shines as though gilded with burnished gold.

The angular pupæ of butterflies, of which these are examples, are among the most beautiful of pupæ. They are often not only gaily decorated, but tinged of a golden colour, which obtained for them among the Romans the name of *aureliæ* ; and among the Greeks, that of *chrysalis*. Linné called them *obtectæ* pupæ.

The pupæ of insects in general, however, do not present much that is beautiful in colour. The nymphs of bees, &c., which I have just described, are usually white, or whitish ; and the *cased-nymphs*, as they are termed, of flies and some other two-winged genera, are generally of a reddish brown. The pupæ of most moths

are brown, of various shades, sometimes varying to black.

FREDERICK.

You said just now, Father, that *most* insects in the pupa state require no food, I thought there were none that did.

MR. B.

In the metamorphoses of insects, as in other things, nature has observed no invariable rule. To by far the greater number the remark strictly applies, that in the pupa state they take no food; still it was necessary to qualify the assertion, because the pupæ of a very considerable number including all the *orthoptera*, that is to say, the well-known tribes of earwigs, grasshoppers, crickets, and locusts, with cockroaches, lanthorn-flies, froghoppers, bugs, plant-lice, dragon-flies, white ants, &c., are equally capable of moving and eating with the larvæ, which they resemble, except in having the rudiments of wings bound down under a skin that keeps them confined. These are called *semi-nymphs*, or *semi-complete pupæ*.

FREDERICK.

Then *all* insects do not lie for a time in a state

of death-like repose. I think the terms larvæ and pupæ ought to be applied only to those that undergo these distinct changes, and not to such as preserve nearly the same form throughout their existence.

MR. B.

It would perhaps be more strictly correct so to confine them : but as all insects vary more or less in their progress from the egg to the perfect state, these terms are found generally convenient.

EMMA.

Spiders do not undergo any change do they ?

MR. B.

Yes, they do ; and so do millepedes, centipedes, mites, scorpions, harvestmen, and various other wingless insects that to a casual observer appear always the same. Some differ in the number and length of their legs ; some, in the number of the segments of the body ; and some, in other particulars, which when you become a practised entomologist, you will understand : they all too in their progress to maturity cast their skins. Linné called such insects *complete pupæ*, because they so nearly resemble the perfect insect.

Now, Emma, can you enumerate the different kinds of pupæ ?

EMMA.

Yes, I think I can. The larva of the butterfly and moth becomes a *chrysalis*; that of the beetle and the bee, a *nymph*; that of the fly, a *cased nymph*; that of the grasshopper and dragon-fly a *semi-nymph*; and that of the spider a *complete pupa*.

FREDERICK.

Do insects remain in the pupa state long?

MR.B.

They vary very much in this respect. Generally speaking, the pupæ of large insects continue pupæ a longer time than those of smaller size. Those of beetles and butterflies, for example, longer than those of bees and flies. Some species remain in this state only two or three days; others, as many weeks or months, or even years. The period depends on various circumstances, such as the season of the year, and the temperature of the climate. The same insects will remain pupæ as long again in our country as they will in India. You probably observed that your silk-worms were about a month in escaping from their prisons; in their natural climate they would have become moths in fifteen days.

EMMA.

One thing puzzles me, Papa, and that is, how these insects that bury themselves deep in the earth or in the heart of trees, manage to find their way out of their tombs.

MR. B.

Coleopterous insects, that is, insects of the beetle kind, thus circumstanced, wait until their organs have acquired sufficient strength and their elytra or horny coverings are sufficiently hardened to protect their filmy wings from damage in forcing their way out. Some are known to be at least a month in reaching the surface after quitting the puparium. It is evident, however, that no delay would enable those without elytræ, such as moths and flies, to make their way out without considerable injury. Many therefore while still within the hard case of the pupa take the precaution, a few days previous to leaving it, to wriggle themselves up to the surface, or when they reside in the interior of trees, to the entrance of their hole. The pupa of the great goat moth may often be seen projecting from openings in willow trees, and that of the common crane fly from the surface of the earth in which it has been buried several inches deep.

MRS. B.

It is a singular fact, that the pupæ of silk-worms appear to have a fixed hour of the day for disclosing the perfect insect; Frederick, I remember, constantly found that his broke forth at sunrise.

MR. B.

Many besides the silk-worm observe a fixed period of the day. The hawk moth of the evening primrose comes forth also at sunrise; the hawk moth of the lime tree as certainly at noon. But the most remarkable insects for punctuality in this respect are the ephemeræ, so interestingly described by Reaumur. “Myriads of these insects issue in clouds from the banks of the Seine somewhere between the tenth and eighteenth of August. They are all disclosed in two or three days, and invariably between the hours of eight and ten in the evening. The seasons of the different crops are not better known by agriculturists, than the time when the ephemeræ are about to shew themselves on the banks of the rivers which they inhabit, is by fishermen. Whatever during the day may have been the temperature of the atmosphere, the hour at which they emerge from the nymph is the

same with the greater number of them : and another hour appears marked beyond which it is no longer allowed them to rise to life and gaiety.

EMMA.

I have often heard of the ephemeræ ; what sort of insects are they ?

MR. B.

They are elegant fragile little creatures with light transparent wings, belonging to the same order as the dragon-fly and the ant lion.

In the larva and nymph state they are aquatic, occupying holes in the banks of streams and rivers, in which during an existence of two or three years they perform the task assigned them by their Maker. That task accomplished, they enter at the appointed hour, on all the joyousness of conscious life. But brief is its duration. At sunset they begin to live ; before sun-rise the short course of most of them is over.

MRS. B.

Short as their life is, it is gaily passed. Their choral dances, viewed by the last rays of the setting sun, have been described as scarcely resembling any thing material.

MR. B.

Allowance must be made for the tints in which a poet dips his pencil, when he describes them as

“Transparent forms, too fine for mortal sight,
Their fluid bodies half dissolved in light,
With airy vestments of ethereal hue,
And glittering textures of the filmy dew,
On whom each beam new transient colour flings,
Colours that change whene’er they wave their wings.”

Still all who have observed them agree that the rapid motion of myriads of them performing their gyrations round any luminous object cannot be witnessed, by the dullest spectator, without astonishment. They completely fill the air like thickly falling flakes of snow, and when seen in the beams of the declining sun, appear like brilliant gems showered down from heaven.

The fishermen call them *manna*. When their brief life terminates, a very large proportion of them fall into the river, affording the fish a grand festival, and the fishermen a good harvest.

But we are a little anticipating our next evening’s entertainment; when the structure and habits of insects in the *imago* or perfect state, will I hope pleasantly engage our attention.

FOURTH EVENING.

Appearance of insects on first quitting the puparium.—Principles of the classification of insects.—Cuvier's system.—First four orders apterous, or without wings; Myriapods, Thysanoura, Parasita, and Suctoria.—Eight orders with wings; Coleoptera, Orthoptera, Hemiptera, Neuroptera, Lepidoptera, Rhipiptera, and Diptera.—Distinctions of sex: females usually the larger; some wingless.—Sexes sometimes differ in colour; males more ornamented; some have larger eyes and antennæ; females alone sting; are the more industrious and skilful.—Age of insects.

I hope, Papa, you are at leisure this evening, said Emma; for the sight of such numbers of insects fluttering and sporting in every direction during this beautiful weather, makes me long still more to become acquainted with them.

I have determined, my love, replied Mr. B., to defer other engagements as far as possible while you are at home, and to make leisure for the gratification of my own inclinations, as well as of your wishes.

We will meet in the study and open the cabinet.

We left our little acquaintance at the point when they are first disclosed from the *puparium*, or pupa case. At this moment the insect is soft, weak, and languid; its parts are covered with moisture, and have so little the appearance which they are about to assume, that the unpractised observer can scarcely believe such a change possible as that which he is soon to witness. I have often, when a boy, watched beetles and butterflies emerging to life; and when I have seen the elytræ of beetles, for instance, instead of being, as I expected, stiff and brilliant, and in their proper place upon the back, feebly folded over the breast, and of a soft leathery substance, and a whitish colour, which exhibited no traces of the several tints that were to adorn them, I have felt, for the moment, bitter vexation at the apparent failure of my hopes.

FREDERICK.

You remind me, Father, of a disappointment I once had, when a little boy. I had taken great care of a chrysalis all the winter, and expected in the spring to see a beautiful butterfly make its appearance, with large and gaily-painted wings; but to my great mortification, the wings,

when it came out, for I watched it coming out of the pupa, were scarcely bigger than my finger nail, and were of such a dull muddy colour, and fell so helplessly over the breast, that I thought it could never come to anything, so I threw it away.

MR. B.

If you had had but a little patience, these symptoms of debility and imperfection would soon have vanished, and your hopes would have been realized by the gradual expansion of the wings, and the exhibition of their various lines and markings. An hour or two generally suffices to give to the insect its proper texture, form, and colour.

Before we proceed to consider insects in their *imago* state, it will be desirable that you should have such a general idea of their classification, as an inspection of specimens will furnish.

EMMA.

What does *imago* mean, Papa?

MR. B.

It is a term applied to the perfect insect by Linné, because having laid aside its mask, and thrown off its swaddling bands, it is become a true representative or image of its species.

The classification of insects, like other artificial classifications, has been founded by different naturalists on various distinctive peculiarities.

Some have arranged them according to the locality in which they are found; whether on land or in water, on plants or on animals. Others, according to the character of their metamorphoses; and others, according to the structure of the mouth; but the system now generally adopted is that of Linné, who founds it on the variety observable in the number and texture of the wings. By the termination *ptera*, you will perceive that Cuvier, whose plan I have followed, adopted the principle of his arrangement.*

EMMA.

Will you tell me Papa, the exact meaning of the word *insect*?

MR. B.

It is derived from the Latin *insectus*, which means indented or notched. If you look at a bee or a fly, you will at once perceive that its body is insected or partially divided into three parts, the head, the trunk, and the abdomen. In Greek, insects are called *entoma* for the same reason; and hence the study of insects is called *entomology*.

* See Plate III.

Cuvier divides insects into twelve orders, of which the first four are *apterous* or wingless.

EMMA.

They consist of spiders and such things, I suppose.

MR. B.

No: on account of various peculiarities in the structure of spiders, he places them in a class by themselves called *arachnidæ*.

His first order of wingless insects are the *Myriapods*, vulgarly named Millipedes; to this belong the various kinds of Scolopendra, Woodlice, &c.

His second order he names *Thysanoura*. You have seen insects of this order, I dare say; one genus of them, the podura or spring-tails, may be compared to little silvery fishes; they run very fast, and are to be found in moist places, under planks and stones. The sugar louse also belongs to it.

His third order, called *Parasita*, is formed of those insects that exist on the bodies of other animals. As they are too disgusting to be dwelt upon, I shall only remark respecting them, that there is no quadruped which has not its particular louse; and that some nourish several.

His fourth order of wingless insects, which he terms *Suctoria*, is composed of the different species of fleas; but as they are nearly as uninviting as the *Parasita*, I shall pass them over also in silence.

My collection begins, you perceive, with his fifth order, the *Coleoptera*,* which comprehends the various species of beetles.

EMMA.

What a great number you have! Papa.

MR. B.

I have some of all the four sections, and of each of the twenty families into which Cuvier divides the beetle tribes; but when I tell you that these families are again divided into sixty-eight genera, and more than six-hundred sub-genera, you will readily believe that I have not specimens of one-tenth of the varieties they include.

The *Coleoptera* far exceed in number of species every other order of insects; for this, and for other reasons, among which I might name the completeness of the metamorphosis they all undergo, from a dull heavy worm to a brilliant beetle, they have always attracted the particular attention

* Plate III. Fig. 5.

of naturalists. Aristotle gave them the name *Coleoptera* because their wings are so strongly protected by a sheath; they are, in fact, clothed in a complete suit of natural armour.

This drawer contains the sixth order of Cuvier, which are called *Orthoptera*, from their wings being folded in a straight or longitudinal direction.

EMMA.

You have some very curious looking creatures among them. Some of them might vie with kangaroos, in the length of their hind-legs;—what is this which has fore-legs almost like hands?*

MR. B.

A mole cricket. A creature as mischievous in its habits, as it is curious in its appearance.

A characteristic of this order more marked and distinguishing than the form of the wings, is that the metamorphosis of insects belonging to it is only partial.

EMMA.

I remember you told me that crickets, locusts, grasshoppers, earwigs, and other insects of that sort, are equally able to walk and feed in all their states.

* Plate III. Fig. 6.

MR. B.

Yes: the pupa differs from the larva only in having the rudiments of wings, which the larva has not; and the perfect insect differs from the pupa, only in having those wings fully matured.

The *Orthoptera*, you see, are divided into two tribes;—the *leapers*, such as crickets and grasshoppers; and the *runners*, such as earwigs.

This drawer contains specimens of Cuvier's seventh order, the *Hemiptera*,* or those with half-cased wings; that is to say, those in which only half of the outer wing is horny. They terminate the *wing-cased* insects. In the *Hemiptera*, however, as in the preceding order, the wings are not the most remarkable feature; some of them indeed, as the bed-bug, have none at all; they are more distinguished from the two previous orders, by not having jaws, but mouths formed wholly for suction. Among them are some disagreeable, and some extremely elegant insects. Like the *Orthoptera*, the larva and pupa very nearly resemble the mature insect in form.

* Plate III. Fig. 7.

FREDERICK.

There are several species of bugs among them, I perceive.

MR. B.

Yes: the first division consists almost entirely of bugs. In the second, I have several valuable specimens of a tribe that have long been famous for their musical powers. I mean the *Cicadariæ* including the *Fulgora*, *Cicada*, *Tettix*, and *Tettigonia* genera. Some of them, particularly the lanthorn-flies, are also remarkably luminous; so that this tribe of insects may be said to

“Beautify and cheer the night
With sprightly song and brilliant light.”

The various species of plant-lice also belong to this order.

The eighth order is called *Neuroptera*.*

EMMA.

How light and pretty their gauze wings are!

MR. B.

We have already noticed the larvæ of one or two insects belonging to them;—the murderous ant-lion, the dragon-fly with his mask, and the fragile ephemeræ. These are, perhaps, the most

* Plate III. Fig. 8.

interesting genera belonging to this order, if we except the *termites* or white ants, of whose remarkable architectural skill, and equally remarkable destructive power, I shall have something to tell you another evening. What does *Neuroptera* mean, Frederick?

FREDERICK.

I suppose it means *nerve-winged*.

MR. B.

You are right. The wings consist of a very fine reticulated substance. Many insects of this order are carnivorous. Some, as the ant-lion, undergo a complete metamorphosis; while in others, as the dragon fly, it is incomplete.

FREDERICK.

This drawer contains my favourites, the *Hymenoptera*.*

MR. B.

I quite agree with you in your preference. It is indisputably the order most deserving attention. Two distinguished naturalists, Mr. Huber and his son, spent their lives in observing the manners and habits of two of the genera belonging to it: the father devoting himself to the study of bees; the son, to that of ants.

* Plate III. Fig. 9.

The characteristics of the *Hymenoptera* are four membranous and naked wings, of which the upper pair are always the larger; and an auger or a sting at the end of the abdomen of the female. They all undergo a complete metamorphosis, and the nursing and care which some of them bestow on the larvæ and pupæ, is an interesting part of their economy.

EMMA.

Well, Frederick, you may have the stinging bees and wasps to yourself as you like them so much; for my part, I greatly prefer the delicate beautiful creatures in this drawer.

MR. B.

The *Lepidoptera** are your favourites, are they? I am afraid, Emma, you are too much influenced by appearances. Do you not think intelligence and industry preferable to beauty?

EMMA.

But, Papa, are not butterflies and moths intelligent and industrious? Almost all you have yet told me of the skill of insects, has been connected with them—with their caterpillars at least.

MR. B.

A very good defence, Emma. I must grant

* Plate III. Fig. 10.

that in their larva state they are the most interesting order of insects. Popular opinion too seems to be in their favour; for no other order, with the exception of beetles, has been so generally studied. Still, I cannot allow butterflies to be at all equal in intelligence to bees and ants. You will be of my opinion when you know more of the economy of these wonderful little creatures.

EMMA.

I do not exactly know the distinction between butterflies and moths.

MR. B.

There are two or three remarkable points of difference. Butterflies when stationary, hold their wings erect, so that you can see only the under sides of them; moths drop theirs in a manner that displays their beauty. The antennæ of the butterfly are very slender, and terminate in a kind of knob; those of moths are often elaborately adorned.

Butterflies fly by day; moths chiefly by twilight, and many only by night.

The order is called *Lepidoptera* from the scaly or feathery covering of the wings.

FREDERICK.

You have no specimens of Cuvier's eleventh order, the *Rhipiptera*.

MR. B.

The insects belonging to it are few, minute, and difficult to obtain. In the larva state they are parasitic, living between the segmentary scales of wasps and some other insects.

EMMA.

None of the insects in this drawer, which appear to be different kinds of flies, have more than two wings, I think.

MR. B.

They are distinguished by that circumstance; The twelfth order is called *Diptera*,* or two winged.

The *Diptera* have, however, something instead of a second pair of wings. Look at this fly which I have put into the microscope; do you not see something like a small wire with a ball at the end projecting from each side of the trunk behind the wings? These little projections are called *poisers*, because some have supposed that they enable the fly to balance its body and obviate all unsteadiness in flight; others, however, are of opinion that they assist respiration; and others, with perhaps more probability, that they are only the rudiments of wings.

* Plate III. Fig. 12.

You have now, I hope, a tolerably correct idea of the twelve orders of insects according to Cuvier's classification; the first four, you will bear in mind, are *apterous*, or without wings: and are called *Myriapoda*, *Thysanoura*, *Parasita*, and *Suctoria*. Of the eight following orders, all of which have wings, three, the *Coleoptera*, *Orthoptera*, and *Hemiptera*, have wing-cases; two, the *Neuroptera* and *Hymenoptera*, have four naked wings; one, the *Lepidoptera*, has four scaly wings; and of the two last, the *Rhipiptera* has two large crossed wings, and the *Diptera* two naked wings, which, though comparatively small, are formed for rapid flight.

EMMA.

I see, Papa, that in several instances, you have two specimens of apparently the same insect, only that the one is smaller than the other; the small ones, I suppose, are not full grown.

MR. B.

Another random guess, my young lady-philosopher. Insects do not *grow* after they leave the pupa.

EMMA.

Well now, Papa, you surprise me very much. I always thought the small flies, for instance,

which we sometimes see on the window, were young ones, that had not done growing.

MR. B.

Then, my dear girl, you have always been under a great mistake. They are an entirely different species. With regard to the insects in the cabinet, where one is rather smaller than the other, they are male and female specimens of the same insect. I shall perhaps surprise you again when I tell you, that the larger insect is, with few exceptions, the *female*.

EMMA.

Indeed!

MR. B.

The disproportion is not, in general, very great; yet sufficiently observable for a practised eye to determine, even in the larva and pupa states, which will become females. There are a few instances, however, in which the female is immensely larger than the male. Reaumur tells us of one species of beetle, of which the male is so small in comparison with his mate, that a bull not larger than a hare contrasted with a large cow, would aptly represent their proportions. The little beetle, he says, has wings and elytræ, while the

giant female is without either. In some species of white ants, (*termites*) the females are even some thousands of times larger than the males.

The mention of Reaumur's beetles reminds me that the females of some other species are also without wings; the common glow-worm, for example, (*Lampyris noctiluca*;) the female cock-roach (*Blatta*;) and the neuters or workers, among the ants.

The sexes sometimes differ also in colour, and that, in some instances, so greatly, that they have been mistaken for different species. This is very often the case in the *Hymenoptera*; you may frequently find males and females among the ichneumons and saw-flies that are wholly dissimilar in colour; and I have here two species of wild bees, in the one, (*Anthophora retusa*,) the male is wholly black, and the female wholly grey; and in the other, (*Osmia coerulescens*,) the male has, you see, a bronzed, and the female, a violet abdomen.

There are several instances of the same difference among the *Lepidoptera*. In the common brimstone butterfly, (*Gonepteryx rhamni*,) which is one of our earliest visitants in spring, the wings of the

male are yellow, those of the female greenish white; and in the common orange-tip butterfly (*Pontia cardamines*,) one sex has not the orange tip to the upper wings. Inattention to this fact led even Linné into mistakes; his Trojans and Greeks are now ascertained to be, in many instances at least, only different sexes of the same species.

FREDERICK.

I have often noticed common dragon-flies (*Libellula depressa*) hawking over a pool of water in company, in some of which the abdomen was of a slate colour, while in others, it was yellow with darker side spots.

MR. B.

Those of a slate colour were the males. The *Libellulidæ* are remarkable for the differences of colour in the sexes. In one species, (*Calepteryx virgo*,) the female is green, and her mate, of a lovely silky blue.

Generally speaking, male insects, though inferior to the females in size, and in another important particular, which I have yet to mention, have a decided advantage with regard to form; they have one segment more in the body than the female, and some are furnished with various

defensive appendages: some have one, two, or even three threatening horns, either on the head or trunk; others have enormous upper jaws. In some, the hive-bee for example, the eyes of the male are much larger than those of the female: while in nearly all, those wonderful organs, whose use is little known to us, the antennæ, are both more complete and more elegant. Look, for instance, at these capricorn beetles; the antennæ of the males are twice the length of those of the females.

EMMA.

Now you mention it, Papa, I remember that I have often observed a difference in the antennæ of gnats. In some, they were thickly fringed with hair on each side, like little plumes; and in others, quite naked and plain. They are not then two different kinds of gnats?

MR. B.

No: they are the male and female of the same species. You never need to be afraid of those with the handsomely plumed antennæ; they are gentle creatures, content with sipping the nectar of flowers. It is the females alone, both among gnats (*Culices*) and horseflies (*Tabanidæ*) whose blood-thirsty disposition there is reason to dread.

FREDERICK.

And it is the females only, I think you just now said, among the *Hymenoptera* that wear a sting.

MR. B.

Yes: to speak the truth, female insects are often of a very unamiable disposition.

EMMA.

After all this, Papa, it is but fair that you should tell us the "important particular" in which as you just now said, female insects are superior to the males.

MR. B.

Well then, Emma, it must be confessed that the females are very superior in industry. They are the *workers*; and while pleasure is the whole pursuit of the other sex, it is on them that the care of providing for future generations devolves. Look at a hive of bees. While the queen and the honey-makers, which are now considered to be also females, are skilful and diligent, wise, active, prudent, laborious and courageous, the males take no part whatever in their cares; but indolently suffer themselves to be maintained at the expense of the community, till their idleness

and cowardice cause them to be expelled from the hive.

EMMA.

Then I do think, Papa, that on the whole, though the males may be the prettier and the more gentle, the females are by far the most deserving of notice.

MR. B.

I think so too, Emma.

FREDERICK.

What is the average term of the life of insects?

MR. B.

It would perhaps be difficult to say. In some, the life is longest in the first states; in others, in the last. It may be taken, I think, as a pretty general rule, that those, whose existence as larvæ is the most extended, live for the shortest period when they attain maturity; and the reverse. Most of the ephemeræ, you know, live as larvæ and pupæ two or three years; as perfect insects, only an hour or two. The cock-chaffer, (*Melolontha vulgaris*,) which in its first state lives four years, as a beetle, lives only eight or ten days; while the flesh-fly, whose larva has attained to maturity in three or four days, will exist for several weeks.

A small number of the larger species of insects, particularly of the *Coleoptera* and *Orthoptera*, have been known to live six, nine, twelve, or even fifteen months; and a very few, two or three years, or even more. Rösel informs us, that he kept a rose-beetle (*Cetonia aurata*) alive for three years, by feeding it with fruit and moist white bread; and Esper kept one of our most common water-beetles (*Dytiscus marginalis*) for three years and a half, by placing it in a large vessel of water, and feeding it with meat. The average life of insects, generally speaking, however, is but a few weeks; and of many species, but a few days or hours.

And yet, though the very type of frailty, though born only to

———Sport in the sunbeam,
And be seen no more,

insects are more complex in their formation, that is to say, their muscles are far more numerous, their nervous system is far more ramified, and they are furnished not only with more complicated, but with a greater variety of organs, than the elephant, the rhinoceros, or the hippopotamus; and all compressed into so minute a bulk,

as scarcely to counterpoise a ten-millionth part of either of those mighty monarchs of the forest and the flood.*

To-morrow evening we will examine more minutely their astonishing structure, so far at least as their external organs are visible to us. The microscope will disclose to our view a world of wonders.

* Kirby.

FIFTH EVENING.

General form of insects.—Head.—Eyes: simple, conglomerate, compound.—Stemmata.—Hearing.—Antennæ the probable organs of hearing; of conversation; of detecting changes in the atmosphere.—Touch probably resides in the palpi and tarsi.—Smell: organs of smell and taste probably in the head.—Insects divided into *Haustellata*, or those that suck, and *Mandibulata*, or those that chew.—Various organs of sucking insects; the *promusci* of bugs, *proboscis* of flies and gnats, *antlia* of butterflies.—Jaws of insects differ in construction.—Lapping insects.—Insects have no voice.

We are this evening, said Mr. B., as he took his seat at the cabinet, to examine the structure of insects, as it is presented to us in their external forms. And first, let us notice in what particulars all insects are alike. Some are so obvious that you cannot fail to observe them.

FREDERICK.

The bodies of all appear to be divided into three parts;—the head, the trunk, and the abdomen; and they all, I mean all winged insects, have six legs and two antennæ.

MR. B.

And all, with the exception of the last two orders, have four wings; so that we might define an insect as a little creature with six legs, four wings, two antennæ, and a body divided into three distinct parts.

But though bearing this general resemblance, how dissimilar are the different orders! Contrast a beetle or a bee with a butterfly, and either of these with a grasshopper or a dragon-fly; how totally unlike! And yet, take each part separately, and you will find, amidst all this variety, a strict adherence to one general plan. This you will perceive more distinctly by looking at them through a microscope.

We will first examine the part which in all animals is the most interesting,—I mean the head. I am not going to point out their lips, and temples, and cheeks, and noses; you laugh, Emma, but, I assure you, grave entomologists do point them out; nor shall I pretend to decide which have *incisor*, which *laniar*, and which *molar* teeth, or whether, like ourselves, any are furnished with them all.—This is beyond my ability, as well as my purpose.

The head is usually larger in the perfect insect than in the larva ; and is supposed to be in insects, as in most other animals, the principal seat of the senses. Internally, it contains the brain ; and externally, the mouth, eyes, and antennæ. Its form is generally that of a triangle, with the angles rounded, the point forming the mouth ; and its substance is harder than the rest of the crust.

The most remarkable and distinguishing features of the head are the eyes and the antennæ. Some *apterous* insects, as fleas, lice, spiders, scorpions, &c., have from two to sixteen *simple* eyes, differing in shape, colour, size, and situation, and placed singly upon the head ; others have what are called *conglomerate* eyes, that is to say, simple eyes collected together : in the common millepede, (*Iulus terrestris*,) there are twenty-eight eyes thus placed together in seven rows, and forming a triangle. But the most common kind of eye, at least in winged insects, is the *compound* eye, of which, generally speaking, they have two. These eyes are composed of a set of transparent crustaceous lenses, so hard, as to require no covering to protect them, and have thus, like multiplying glasses, innumerable surfaces, on every one of which the

object is distinctly formed ; so that if a candle be held opposite to them, it appears multiplied almost to infinity.

EMMA.

Then they see every single object multiplied to an immense number.

MR. B.

O no : I do not suppose that. You have two eyes, but you do not see things double ; do you ? By the compound structure of their eyes their power of vision is strengthened and their field of viewed enlarged ; without it indeed, as their eyes are immoveable, they could have seen but little ; but some one or other of these minute hemispheres being always directed towards objects from whatever quarter they present themselves, nothing can pass unobserved. These lenses, which amount to a greater or less number in the eyes of different insects, give to them the appearance of net-work. Look at the eye of this fly* in the microscope ; it appears traversed, you observe, by numberless parallel lines, with others, equally numerous, intersecting them at right angles, so as apparently to form myriads of little partitions each with a lens set in it.

* Plate I: Fig. 9.

I have here a drawing of a small part of a butterfly's eye, magnified two hundred thousand times,* which will give you some idea of the manner in which these lenses are set. The sockets, you see, are hexagonal, and are fringed with eye lashes; the lenses are circular and transparent, convex on the outer surface and concave within, but thicker in the middle than at the edge. Of these lenses, thus curiously formed, and exactly set, no less than seventeen thousand three hundred and twenty-five have been counted in one eye of a butterfly.

FREDERICK.

I had no idea that they were so immensely numerous.

MR. B.

In one genus of beetles, (*Dynastes*,) they are said to be even much more numerous than this : but the number varies in different insects. In the eye of another species of beetle Mr. Leeuwenhoek counted three thousand one hundred and eighty one; in that of the common house-fly, eight thousand; and in that of a dragon-fly, twelve thousand five hundred and forty four.

EMMA.

I could never have thought that the eye even

* Plate I. Fig. 10.

of a little insect contained such inconceivable wonders.

MR B.

The wisdom of God is displayed, my dear Emma, in the minuteness of his works as much as in the vastness of them : in the myriads of perfect lenses composing the eyes of each of the millions of insects that sport in the cheering warmth of the summer's sun, as much as in the structure of those suns and worlds with which the wide expanse of the universe is filled.

FREDERICK.

You just now mentioned the number of lenses in the eye of a dragon-fly ;—I think I have read of some curious experiments which Mr. Leeuwenhoek once made with the eye of one of these insects. With the aid of a microscope used as a telescope he viewed the steeple of a church through it ; he could plainly see the spire, though not apparently larger than the point of a fine needle : he also looked at a house, and could discern the front, distinguish the doors and windows, and perceive whether they were shut or open.

MR. B.

So he fancied.

Besides these compound eyes, which from their high magnifying powers, are probably intended chiefly for surveying more distant objects, a large portion of insects are provided with a kind of auxiliary eyes, called by Linné *stemmata*; they are simple, usually three in number, and placed between the other eyes, for the purpose, it is thought, of enabling the insect to examine more distinctly objects that are near. These organs are very conspicuous in the common hive-bee.

EMMA.

Insects have the sense of sight then in great perfection.

MR. B.

And all the other senses. They can not only see, but, it is evident, that they can also hear, and touch, and taste, and smell; though in what manner, that is to say, through the medium of what organs, it is not so easy to decide. The remark of Fabricius, the distinguished Danish naturalist, that “nothing in natural history is more abstruse and difficult than an accurate description of the senses of animals,” is especially true with regard to insects. That they possess all the senses, there can be little doubt; but where they are placed,

and how they are exerted, will perhaps ever remain matter of enquiry and speculation.

FREDERICK.

Is it certain that they can hear?

MR. B.

Yes. Some larvæ even appear to have the power of hearing. Bonnet tells us of a species of caterpillar that was moving very swiftly, but instantly stopped, and put the anterior part of the body into brisk motion, at the sound of a small bell. That insects possess this faculty in their mature state, is still more strongly confirmed by facts. Mr. Kirby says that at brisk and distinct sounds, he has observed flies to move all their legs, and spiders to quit their prey, and retire to their hiding places. A very satisfactory proof, as Mr. K. remarks, that insects can hear, is to be had from those *Orthoptera* and *Hemiptera*, whose males are vocal. Brunelli kept and fed in a closet several male grasshoppers, (*Acrida viridissima*,) which continued singing merrily all the day; but a rap at the door would stop them instantly. By practice, he learned to imitate their chirping. When he did this at the door, at first a few would answer him in a low note,

and then the whole party would take up the tune, and sing with all their might. He once shut up a male in his garden, and gave the female her liberty; but as soon as she heard the male chirp, she flew to him immediately. If you wish to catch a grasshopper, you must approach very gently; it will cease chirping at the sound of a footstep, even at some yards distant. Goldsmith tells a story of a house being cleared of crickets, with which, to the annoyance of the inmates, it had long been infested, by a loud band of music at a wedding.

EMMA.

But where are their ears, Papa?

MR. B.

That, Emma, as I just now stated, is a question more easily asked than answered. It seems probable, I think, that the antennæ answer this purpose. They stand out from the head in a manner analogous to the ears of vertebrated animals; and their number, always two, corresponds to them. Some experiments that have been made appear also to prove that whatever other purposes these wonderful organs may answer, that of hearing is at least an important one. Mr. Kirby tells us

that on making a quiet, not a loud but a distinct noise, a little moth, that was reposing upon his window, immediately moved towards him the antenna that was nearest to him. He repeated the noise at least a dozen times, and it was followed every time by the same motion of that organ; till at length, the insect being alarmed, became more agitated and violent in its motions.

It is very difficult, as I just now remarked, even to conjecture on the senses of animals, whose perceptions are so much more delicate and keen than our own, and appear indeed to commence where ours terminate. There is little doubt that

“They hear a sound we cannot hear,
They see a sign we cannot see;”

but *how*, it is beyond our power to determine. As we know, however, that their eyes are admirably adapted for sight, it is not unreasonable to suppose that their antennæ may be equally well adapted for hearing. Who can tell that every joint of some of them at least is not an acoustic implement?

Let us examine these organs a little more particularly. You observe that every insect has two, and only two antennæ; which are placed

in most cases, in the space between, or a little below the eyes, not behind them; and that they consist, in general, of a number of tubular joints. Though in structure alike, they vary exceedingly in size and shape. Some resemble slender threads, others are thick and broad; some are very long, others remarkably short; some are what botanists would call *pectinate*; others, *palmate*; others, *serrated*. Kirby and Spence describe thirty-two different sorts of them.

FREDERICK.

Yes: I perceive they are very various. In dragon-flies they are scarcely perceptible; while in crickets, they are longer than the body. The beetles seem to have the greatest variety of them. Why are they called *antennæ*, Father? *Antenna* in Latin means the yard of a ship's mast.

MR. B.

The name was probably adopted from an idea long since exploded, that they are useful to insects in flight. Aristotle called them by the scarcely more suitable name of *horns*. The truth is, that we know so little of their uses, that it is difficult to agree upon an appropriate name.

M. Huber and his son supposed that, in the *Hymenoptera* order at least, the antennæ are the organs of conversation, as well as of hearing. They tell us of "the antennal language," as they call it, both of bees and ants. According to them, ants have been observed to intimate to their friends the approach of danger; to ascertain their own party when mingled with the enemy; to warn their companions in the interior of the ant hill of the presence of the sun; to indicate their route in their excursions; to give the signal for departure; and even when hungry, to ask of others food, by striking those they meet in an impressive manner with these organs, the effect of which intelligence has been immediately perceptible.

With regard to bees, the elder Huber made some curious experiments, which seem to prove this use of the antennæ. Wishing to ascertain whether, when these sagacious insects have lost a queen, (intelligence of which is conveyed throughout the hive in about an hour,) they discovered the sad event by their smell, their touch, or any unknown means, he first divided a hive by a grate, which kept the portions about a quarter

of an inch apart, so they could have no intercourse, though scent could pass. In that part in which there was no queen, they were soon in great agitation, and in a short time began to construct royal cells. He then separated a hive by a partition, through which they could pass their antennæ, but not their heads. In this case, the bees all remained tranquil. To assure themselves that their queen was in their vicinity, and to communicate with her, they passed their antennæ through the openings of the grate, and a great number of these organs might be seen at once, enquiring as it were in all directions, while the queen was observed fastened by her feet to the grate, and assiduously replying to these solicitous enquiries of her subjects, by crossing her antennæ with those of the enquirers.

EMMA.

I wonder what would be the effect of depriving an insect of its antennæ.

MR. B.

It would become listless and inactive; for these remarkable and inexplicable appendages seem to be intimately connected with its sentient powers. It is probable, that by means of them,

as Mr. Kirby remarks, they not only receive from the atmosphere notices of sounds, but discover alterations in its state, and foretel, by certain prognostics, when a change of weather is approaching. Bees, Mr. K. says, possess this prophetic faculty in a wonderful degree. When engaged in their daily labours, if a shower is approaching, though we can discern no signs of it, they foresee it, and return suddenly to their hives. If they wander far from home, and do not return till late in the evening, it is a prognostic to be depended on that the following day will be fine; but if they remain near their habitations, and are seen frequently going and returning, although no other indications of wet should be discoverable, clouds will soon arise, and rain come on.

FREDERICK.

I have sometimes observed that on the approach of a tempest, the air is unusually full of insects.

MR. B.

And have you not also observed that before the storm comes on, all disappear, and scarcely one is to be seen?

EMMA.

Their antennæ then answer the purpose of barometers as well as of ears.

MR. B.

So it has been conjectured. But perhaps the hairs with which many are thickly covered, also assist them in discovering the electric and other fluids dispersed in the atmosphere.

FREDERICK.

Are not the antennæ their instruments of touch? I have observed that some keep them in continual motion.

MR. B.

They are perhaps in part; but most insects are also furnished with palpi or feelers, which, as well as their tarsi or paws, appear to be employed for this purpose. The palpi are these projections near the mouth; they are usually four in number, cylindrical, smooth, and ending in a softish point. The upper pair, you see, are, in most cases, rather longer than the under, so that they reach the ground at the same time. If you place an insect on your hand, you may perceive that it continually applies its palpi to feel the surface on which it is moving. When it feeds also, it keeps them in constant activity upon the substance on which it is feeding.

FREDERICK.

Perhaps then the palpi assists insects in smelling and tasting.

EMMA.

I can scarcely believe that they can smell and taste : they often eat such disagreeable things.

MR. B.

Things that are disagreeable to *us*, Emma ; and so are the train oil and putrid seal's flesh of the Greenlander, and the assafoetida that gives so high a goût to the dishes of the Affghans. That insects can both taste and smell, is abundantly evident from the preferences they shew, and the intrusions of which they are guilty. To say nothing of the odours which many of them emit, what but the sense of smell can attract them to our choicest fruits and flowers, and enable them to distinguish the grocer's shop, and the butcher's stall? However carefully we conceal its favourite viand, the insect comes, lured by the scent, and uses every effort to gain access to the place from whence it emanates.

Some physiologists have conjectured that the sense of smell resides in the palpi ; others, in the antennæ ; and others have maintained that, as

insects breathe through their sides, they must needs smell through them too, not considering that though we breathe most freely through the mouth, the faculty of smell resides only in the nose. Mr. Spence thinks that the senses both of smell and of taste are seated in the head, and perhaps pretty much in the same situation that they are in other animals; and an experiment which M. Huber made, inclines me to be of the same opinion. He applied with a fine hair pencil, some oil of turpentine, to the smell of which bees have a particular dislike, to the abdomen, the trunk, the eyes, the antennæ, and the head of a bee, without any effect; but when he pointed the pencil near the cavity of the mouth above the insertion of the proboscis, the little animal exhibited the most extraordinary agitation.

EMMA.

Then insects really have noses!—Perhaps they have also tongues and palates for tasting.

MR. B.

They have tongues, Emma, certainly; and therefore in all probability they are the organs of taste.

The mention of the tongue leads me to make

a remark or two on the *mouths* of insects. I have before hinted that, in reference to the structure of the mouth, insects are divided into two extensive groups:—the *Haustellata*, as they are called, or those that take their food by suction; and the *Mandibulata*, or those that bite it. Among the *Haustellata* are the wingless insects, such as lice and fleas, with the *Hemiptera*, *Lepidoptera*, and *Diptera*; or bugs, butterflies, crickets, and flies. The *Mandibulata* include the insects most distinguished for character and intelligence;—that is to say, the *Coleoptera*, *Orthoptera*, *Neuroptera*, and *Hymenoptera* orders, among which are beetles, locusts, dragon-flies, and bees; though as bees never use their jaws for mastication, but really lap their food with the tongue, they may more properly be denominated *lappers*.

I cannot enter into a minute description of the varieties observable in either of these divisions. In the *Hemiptera*, the insect has a hollow grooved beak, containing four slender threads, which the little creature inserts into the substance, whether animal or vegetable, on which it feeds, and through which it sucks up the juices that form its nutriment. Entomologists call this sort of mouth the *promuscis*.

When at rest, it is usually laid between the legs. You may see it in this bug which I have put into the microscope.

Gnats, horseflies, and other *Diptera* are provided with a *proboscis* or trunk, on the same general plan, but of a more complicated structure, by means of which they puncture the skin, and suck in the blood. You may easily watch the process for yourself, if you will allow one to settle on your hand. Some of these have but one lancet; others three; the horse-fly has four, and the blood-thirsty gnat five: some acutely pointed at the extremity, others jagged on one side like a saw.

Butterflies and moths are still more elegantly furnished with a tube, or *antlia*, as Mr. Kirby calls it; in some, not less than three inches long; which is admirably fitted for extracting the honey secreted in the nectaries of flowers. This tube, when not in use, is coiled up under the head, like the spring of a watch. You see it in this nettle-butterfly,—with the point of a pin, Emma, you may easily unroll it. The *antlia*, which is a cartilaginous substance, apparently composed of a series of minute rings, and moved by an equal

number of distinct muscles, is in fact composed of three distinct tubes; two on the sides for the reception of air, and one in the centre, through which alone the honey is conveyed, formed of two separate grooves, which, by a most curious apparatus of hooks, like those in the lamina of a feather, can either be united into an air-tight canal, or instantly separated at the will of the insect. I have here a highly-magnified drawing of it.* By darting this organ, which the insect has the power of instantly unrolling, into the bottom of a flower, it draws up through it a supply of the delicious nectar.

EMMA.

How very wonderful!

MR. B.

It is indeed. How different this trunk from the voracious jaws of the larva!

FREDERICK.

It is remarkable that the instruments of nutrition in insects in the larva and perfect states should often differ so much. While larvæ, I suppose, all the *Lepidoptera* are furnished with jaws.

* Plate I. Fig. 6.

MR. B.

Yes : and so are some of the *Diptera*.

FREDERICK.

Is there much variety in the mouths of those insects that masticate their food ?

MR. B.

Yes : their jaws are of very different constructions ; but all, as Mr. Kirby remarks, admirably adapted for their intended services. “ Some are sharp, and armed with spines and branches, for tearing flesh ; others are hooked for seizing, and at the same time hollow for suction ; some are calculated like shears for cutting leaves ; others, more resembling grindstones, are of a strength and solidity sufficient to reduce the hardest wood to powder.” One singularity attending the major part of masticating insects is, that they possess in fact two pairs of jaws, an upper and an under pair ; both opening, as I told you was the case in the larva, not vertically as ours do, but horizontally, or from side to side. The upper pair are apparently for the seizure and mastication of their prey ; the under, when hooked, for retaining and tearing, while the upper comminute it, previously to its being swallowed.

I have here a front view of a locust's head,* taken so as to exhibit the mouth, which will give you a general idea of this construction.

EMMA.

You said just now, Papa, that bees do not use their jaws for mastication;—then of what use are they?

MR. B.

They find them very useful as tools in their various mechanical arts and labours; to some of the *Hymenoptera*, “they supply the place of trowels, spades, and pickaxes; to others, that of saws, scissors, and knives,—with many other uses.” A piece of honeycomb, or a wasp's nest, will furnish you with ample proof of their utility.

Would you like to see a bee lap? One has just flown in at the window, which we will put under a tumbler, placing a drop of water on the edge, and with a magnifying glass you may readily witness it. Do you not perceive its long tongue darted out from the sheath, and already employed in quaffing the refreshing beverage?

FREDERICK.

I was not aware that any insects took water.

* Plate I. Fig. 7.

MR. B.

To several, particularly bees and ants, it is nearly as essential as it is to ourselves, and they lap it with great eagerness. Locusts are very fond of drink; they search with their antennæ for the dew-drops that hang upon the leaves, and sip them with avidity; many butterflies, and moths too, especially in warm climates, are so eager for water, that they are chiefly to be taken near the margin of drains. Even some larvæ have been seen to swallow it; there is one species, it is said, (*Odenestis potatoria*,) that after drinking, lifts up its head like a hen.

Well, we have spent more than an hour upon the tiny insect's head, and must defer till to-morrow the examination of the equally interesting body and limbs.

EMMA.

It has been an agreeable hour, Papa, and seems to have passed away very quickly. Perhaps you will answer just one more question, and that is, how such little creatures manage to make so much noise, as many of them do.

MR. B.

Not with the voice, Emma, for they have none;

that is to say, no insect emits any sound from the mouth.

FREDERICK.

Does not the death's-head moth? I once caught one, and as long as I held it in my hand, it uttered a strong sharp cry, resembling the squeaking of a mouse, only more plaintive.

MR. B.

The sound was not produced by the mouth, but by the friction of the palpi against the *antlia* or spiral tongue, which I just now described to you.

Insects of booming or humming flight appear to produce the sound by the vibration of their wings, occasioned probably by their friction against the trunk. If you watch a bee, as she passes from flower to flower, you will observe that when she alights to collect the nectared treasure, the hum ceases, but that it is resumed the moment she leaves it, and her wings are again in motion. The chirping of the cricket tribes is caused by the friction of the bases of their *elytræ*, or wing-cases, against each other.

SIXTH EVENING.

Structure of insects continued.—Divisions of the body : abdomen, trunk, legs.—Immense strength of insects ; instanced in locusts, fleas, beetles, &c., and proved by their great agility. Linné's remark upon it.—Adaptation of the legs of insects to their modes of life.—Suckers of the feet of flies.—Insects distinguished by the number of joints in their tarsi.—Claws, foot-cushions.—Wings of insects.—Flight of the Coleoptera, Orthoptera, Neuroptera, Hymenoptera, Lepidoptera, and Diptera.—Supposition respecting the employment of flies.—Speed of their flight.—Covering of the wings of insects : of those of the Lepidoptera.—Proofs that insects are not endowed with much acuteness of feeling.—Modes of catching them.—Proofs that they have stated periods of repose analogous to sleep.—Best manner of killing and of setting them.

Now, Papa, will you open the cabinet again, and let us go on with the structure of insects. We have had only the head yet, you know : you must have a great deal more to tell us.

MR. B.

A great deal more remains to be told, my love, than you could possibly understand. I have selected, however, a few obvious facts, which cannot fail to interest you.

I pointed out to you in the larva, that the body is divided into rings or segments.* The number of them, including the head, is usually thirteen. In the perfect state, the insect still retains these thirteen segments; they are, however, no longer all alike, but combined into the separate divisions of head, trunk, and abdomen; the trunk containing three, and the abdomen nine.

Of the abdomen, I shall say little. Along the sides of it are arranged a principal part of the organs of respiration, that is to say, of the spiracles or orifices, by means of which, as I before told you, insects breathe; it may therefore be considered as the chief seat of the vital powers. In the majority of insects, it is united to the trunk by the whole diameter of its base; but in most of the *Hymenoptera*, and in some of the *Diptera*, the union is formed by a kind of pedicle or footstalk. As you are familiar with botanical terms, I will just say, that this slender pedicle is called the *petiolus*.

EMMA.

I have observed it in wasps. In some of the *Hymenoptera* you have here, it is long, but in others it is very short.

* Plate I. Fig. 2.

MR. B.

The mechanism of the *petiolus*, by means of which the insect is enabled to lift the heavy abdomen, is, according to Mr. Kirby, very wonderful. "You would be surprised," he says, "were I seriously to assert, that these insects lift their weighty posteriors by means of a rope and pulley, yet something like this really does take place."

The trunk is a still more remarkable part of the insect; it is the great centre of motion, and the support and prop both of the head and the abdomen.

FREDERICK.

It contains I suppose the muscles by which all the limbs are moved.

MR. B.

Yes: and if you should ever study entomology with the eye of an anatomist, you will be surprised at its complex and varied mechanism.

The trunk or *thorax* consists, as I have just said, of three principal divisions; of which the first, or that nearest the head, is usually more distinct from the other two, than they are from each other. This is sometimes called the *manitrunk*, because the fore-legs, or arms, are attached

to it. The other two, which in many insects form but one piece without any separation, are called the *alitrunk*, because while below they each bear a pair of legs, above they bear the organs for flight. I have partially dissected a beetle*, (*Calosoma sycophantis*,) in order to give you a clearer idea of these sections:—the first, you perceive, bears, as I just now said, the two arms; the second, the intermediate legs, and the elytræ or primary wings; and the third, the hind legs and the secondary wings.

EMMA.

I never observed that there was any difference between the fore legs of insects and their hind ones.

MR. B.

Your observations hitherto, my dear Emma, have been of a very superficial character.—Look at any of the insects before you, or at the positions of any living ones you may happen to meet with, and you will perceive that the anterior legs uniformly point towards the head. If you observe them in motion, you will see that almost all not only employ these legs for taking hold of substances, but that they also climb by them, something as

* Plate II. Fig. 7.

monkeys do. Some use them to seize and despatch their prey; and others, the mole cricket for example and other burrowing insects, employ them for digging. In the mole cricket, you see, they are really formed something like hands. Did you never notice flies cleaning themselves, how busily they rub and wipe the head and trunk with these arms?

FREDERICK.

Moses describes insects as going upon four legs*, which seems as if he considered the two front legs as you do.

MR. B.

Very well remarked, Frederick: In this case, as in numerous others, the inspired penman corroborates the observations on nature which we make in the present day.

In one respect, the arms and legs of insects are alike. They both generally consist of five pieces or joints,—the *coxa* or hip,—the *trochanter*;—the *femur* or thigh, which is usually the longest and most conspicuous part;—the *tibia* or shank,—and the *tarsus* or foot.

* See Leviticus xi. 20—23.

FREDERICK.

The *coxa* or hip is, I suppose, the joint that connects the leg with the trunk.

MR. B.

It is; and its form bears a strong resemblance to the ball and socket joints by which our limbs are united to the body. The *trochanter* is the second joint of the leg, and may be considered analogous to what is vulgarly called the *kneepan*.

FREDERICK.

One thing that strikes me in looking over the cabinet is, that the legs of different insects, though composed of the same number of parts, are often very different in size and conformation.

MR. B.

Adaptation is a distinguishing feature in all the works of God. So uniformly is this regarded, that from the form of the animal, it is generally easy to predicate its habits and modes of life. The large thick thighs observable in the hind-legs of many beetles, and of all the locust tribes, allowing space for the action of powerful muscles, indicate them to have great strength of limb for running and leaping; while the light and slender

legs of others prove that they are not designed for long sustained pedestrian efforts.

FREDERICK.

All the beetles appear to have rather stout strong legs when compared with those of some other orders.

Ms. B.

The *Coleoptera* are altogether very powerful insects; the strength of a cock-chaffer has been computed to be, bulk for bulk, six times that of a horse; and that of some beetles a thousand times that of a man. You soon perceive a beetle's strength if you attempt to hold one in your hand. I may add, that insects generally in their perfect as well as in their larva state, are endowed with great muscular power, as their activity sufficiently evinces. A locust or a flea will leap two hundred times its own length; and Rösel asserts that the mole cricket is capable of pushing forward with his fore feet on an even surface a weight of six pounds.

EMMA.

I remember, now you mention the strength of fleas, reading of one that drew a silver cannon supported on two little wheels which weighed

eighty times as much as itself, and with which it ran along with the greatest ease.

MR. B.

Hook tells us something more wonderful still.—An English artist constructed an ivory coach with six horses, having a coachman on the box, with a dog between his legs, a postillion, two footmen behind, and four persons within, which was also drawn by a single flea !

The agility of insects is also, as I have just said, a proof of their immense strength. Not only do beetles, those predaceous ones especially, which Linné has denominated “the tigers of the insect world,” run with astonishing rapidity, but some more minute insects, ants and flies for instance, move with inconceivable speed. Mr. Delisle observed a fly, so small as to be almost invisible, which ran nearly three inches in a demi-second, and in that space made five-hundred and forty steps ; which is equal to the speed of a man, who should run at the far more than railroad pace of twenty miles in a minute.

FREDERICK.

It is fortunate for us that animals of large size have not been endowed with a muscular power proportionable to that of insects.

MR. B.

It is indeed. If the elephant, as Linné has observed, were strong in proportion to the stag-beetle, it would be able to pull up rocks by the root, and to level mountains; and were the lion and the tiger as strong and swift for their magnitude as those tigers among insects, the *Cicindela* and the *Carabus*, nothing could have escaped them by precaution, or withstood them by strength. But to return to the legs of insects.—

EMMA.

Why have crane-flies such long legs?

MR. B.

You have heard of the shepherds of Les Landes, in the province of Bourdeaux, who, to make their way over the deep mire of winter and sands of summer, always walk on high stilts;—the long legs of these flies answer a similar purpose, and enable them to move with ease over and among the grass, for the purpose of depositing their eggs.

If you attentively examine the legs of insects, you will see that their adaptations consist not alone in their proportions. Look, for example, at the hind-legs of this water-beetle, (*Dytiscus marginalis*,) or of this water-boatman (*Notonecta*,)

how peculiarly they are fitted for swimming by a dense fringe of hair on the shank and foot; while those of others, of the stag-beetle (*Lucanus*) for instance, with their jointed tarsi and claws, are equally well adapted for walking.

EMMA.

I have often wondered how flies and other insects of that sort manage to stand and walk, not only on the window and wall, but even on the ceiling, as they do.

MR. B.

They are furnished, my dear, with an apparatus, by which they can form a vacuum, so as to adhere by atmospheric pressure to the surface on which they are moving. You remember that when you laid your hand over the tube of the air-pump the other day, as soon as the air under it was exhausted, the vacuum caused it to adhere to the tube;—just in the same manner a vacuum which is produced under the skinny palms of some insects' feet, enables them to walk or to repose on the ceiling, with as much ease as they could do on the floor, and with more safety. This highly magnified drawing of the foot of a large fly* (*Musca vom-*

* Plate II. Fig. 7.

toria) will give you an idea of this structure. It is formed, you see, of "two suckers connected with the last joint of the tarsus by a narrow infundibular neck, which has power of motion in all directions, immediately under the root of each claw. These suckers consist of a membrane capable of extension and contraction; they are concavo-convex, with serrated edges, the concave surface being downy, and the convex, granulated. When in action, they are separated from each other, and the membrane is expanded, so as to increase the surface; by applying this membrane closely to the plane of position, the air is sufficiently expelled to produce the pressure necessary to keep the animal from falling. When the suckers are disengaged, they are brought together again, so as to be confined within the space between the two claws." One of these large flies has just alighted on the table; we will put a tumbler over him, and by the assistance of a common microscope you may see, as he moves on the glass, the action of these suckers for yourself. It is the fixing of them that produces the stinging sensation you sometimes feel, when flies alight upon you.

EMMA.

But when my hand was held down on the

air-pump, I could not possibly move it; which I did not wonder at when you told me that a column of air of more than two hundred pounds weight was resting on it:—how is it that flies do not find the weight of the air an impediment to them?

MR. B.

Do you not remember what we just now said about the immense muscular power of insects? Flies are far stronger than you, you know. In the autumn, however, when the chilly weather makes them torpid and feeble, you may observe that they move with difficulty, and are scarcely able to lift their legs, which seem as if glued to the glass,—just as your hand seemed glued to the air-pump,—and by degrees, many do actually stick till they die on the place.

FREDERICK.

Looking attentively at the feet of insects, I perceive that they vary in the number of joints.

MR. B.

They do. Some, and indeed the greater number, have *five* joints in all their tarsi;—these are termed *pentamerous* insects: in others, the number of joints differs in the different pairs of legs; these are called

heteromeric insects : in others, all the tarsi consist of *four* joints ; they are said to be *tetrameric* : in others, the lady-bird (*Coccinella*,) for instance, they consist of only *three* joints ; these are called *trimeric* others, that have only *two* joints, are called *dimeric* ; and the very few that have but *one*, *monomeric*.

FREDERICK.

I see the arrangement of the *Coleoptera* depends on this circumstance.

MR. B.

Yes : that class is divided into four sections according as the insects belonging to it are *pentameric*, *heteromeric*, *tetrameric*, or *trimeric*. You observe that the *pentamera* and the *tetramera*, those with five joints, and and those with four, are by far the most numerous.

The claws of insects are of too great use to them to be passed by unnoticed. It is by means of these implements, that the tree-chaffer, (*Melolontha vulgaris*,) the rose-chaffer, (*Cetonia aurata*,) and other predaceous tribes, ascend the plants and trees in pursuit of their prey, and maintain their station on the vegetable beauties they are laying waste. Look through the microscope at those

of this beautiful though ferocious insect (*Colosoma sycophanta*) which I have dissected, and you will judge how useful they must be in enabling it to mount the rugged trunk and branches of the oak, and to retain its grasp of the leaf or spray, of which it has taken hold. See how very acutely hooked they are. It is no wonder that it is so difficult to detach a beetle from the plant on which it is found. These claws, however, prevent their walking with equal ease on very smooth surfaces. Beetles cannot climb the window as they climb a tree; those at least that have no other climbing implements than their claws.

FREDERICK.

I have observed some to climb smooth surfaces, and even to support themselves against gravity. The bloody-nose beetle (*Timarcha tenebricosa*) can; I have seen it adhere to the under part of the trailing plant on which it feeds, with the greatest ease.

MR. B.

Many tribes are able to do this; but in this case they are furnished with *foot cushions*, composed of thickly-set hairs, with which the under side of the joints of the tarsi are covered. These

cushions are particularly conspicuous in the *Chrysomelidæ*, a beautiful tribe of plant-beetles.

Let us now look for a few moments at the *wings* of insects.

Every wing consists of two transparent membranes, applied to each other. Between these membranes lie the veins or *nervures*, as they are termed, that sometimes give to the wings of insects a reticulated appearance. These nervures, which are most numerous in the wings of those insects that are of the most untiring and rapid flight, are hollow tubes, that take their origin in the trunk, and being furnished with air-vessels, which can be filled with air at the will of the insect, give tension to the wings, and render them buoyant; so that the little creatures can soar aloft, join in the choral dance, and hum their notes of joy at an elevation in the air which is beyond the ken of human vision.

EMMA.

I should think beetles with their stiff horny wings, cannot fly either very high or very fast.

MR. B.

Very few of them can. In regard to flight, the *Coleoptera* are considered the most imperfect of

four-winged insects; they use their wings indeed only upon great emergencies, and as a last resource. If you touch, or but attempt to touch, a moth, a bee, or a fly, or other winged insect, he flies away in a moment; but if you touch a beetle, he either throws himself on his back and counterfeits death, or he runs off with all possible speed. It is indeed to the strength of his legs, far more than to his wings, that he trusts on all occasions.

The *elytræ* or stiff horny wings, as you call them, are not, however, implements of flight. They are only the covers or cases of the wings, and in flight are generally motionless. The proper wings, which you will find folded up under them, are usually very ample, and present in their substance, which is generally of a character between membrane and parchment, and in the large nervures that traverse and extend them, that appearance of strength for which this class of insects is pre-eminently remarkable. Did you ever observe a beetle flying? It maintains a nearly vertical position, which gives to the larger sorts a very singular appearance.

Very few people are aware that earwigs (*For-*

ficula) have wings; but they are furnished with very curious, and in proportion to their size, with very ample ones. I will endeavour to open one, that you may see it. It lies very neatly folded up under the little elytra. Its shape, and the arrangement of the nervures, give it a fan-like appearance.

EMMA.

Can the other *Orthoptera*, such as locusts and crickets, fly?

MR. B.

Have you forgotten, my love, that locusts sometimes fly in such clouds as to darken the air? House crickets, and also field and mole crickets have been observed to fly with an undulating motion, like a woodpecker, alternately ascending with expanded wings, and descending with folded ones; locusts probably fly in the same manner.

FREDERICK.

The *Neuroptera* seem admirably formed for flight. How elegant the wings of these dragon-flies (*Libellulinæ*) are; all four nearly of a size, and formed of a pure, transparent, glassy membrane, closely intersected with nervures like a beautiful piece of network, or fine lace.

MR. B.

They are insects of very rapid flight. I have sometimes been amused to watch a swallow in pursuit of one; and to see that, with all his swiftness, he was unable to overtake and entrap it. Such indeed is the power of the long wings of these insects, and such the force of the muscles that move them, that they seem never to be wearied with flying. You may see them sailing for hours over a piece of water, sometimes to and fro, sometimes wheeling from side to side, without ever appearing tired or disposed to alight.

Another faculty which dragon-flies in common with some other insects possess, and which enables them still more effectually to elude the pursuit of birds, is that of being able to fly in all directions without turning. By constantly facing the enemy they effectually prevent surprise.

The *Hymenoptera* are also insects of active wing.

EMMA.

Indeed they are. If you offend a wasp or a hive of bees, it is no easy matter to escape their vengeance.

MR. B.

The peaceful and gentle humble-bees are the

most powerful fliers among them. If you notice them in flight, you will see that they traverse the air in segments of a circle, and with a rapidity far exceeding in proportion to their size, that of any bird.

FREDERICK.

I love to watch butterflies fluttering on their broad painted wings from flower to flower, and from field to field.

MR. B.

Their fluttering is occasioned by the weight of the scales with which their wings are covered. The distance to which some *Lepidoptera* will fly is astonishing. The male of one species of silk-worm (*Attacus paphia*) is said sometimes to travel to a distance of more than a hundred miles; and our most beautiful butterfly, the purple emperor, (*Apatura iris*,) launching into the air from one of the highest twigs of some lofty monarch of the forest, often mounts to so great a height as to become invisible.

“Above the sovereign oak a sovereign skims,
The purple emperor, strong in wing and limbs.”

FREDERICK.

He must indeed be “strong in wing and limbs,”
to be able to soar to such inaccessible heights.

MR. B.

The wings of the *Lepidoptera*, particularly of the larger species, are exceedingly strong, both as to nervures and texture. How powerful must be those of hawk-moths (*Sphinx*,) for example, to enable them, notwithstanding the weight of their large bodies, to sustain such rapid flights !

FREDERICK.

Hawk-moths fly very differently from butterflies. Their course is direct ; when that of butterflies is by dipping and rising alternately.

MR. B.

They fly, you remember, in the twilight or by night, when birds are asleep ; the zigzag course of the diurnal *Lepidoptera* is doubtless designed as a means of defence against these predaceous enemies. It is very difficult for a bird to catch a butterfly on the wing.

EMMA.

I often watch with interest the aërial progress of flies, now dancing up and down, now darting first in this direction and then in that, as if in pursuit of prey.

FREDERICK.

Do you not think, Father, they really are in

pursuit of prey? Mr. Burnett, in his *Outlines of Botany*, states, you know, that the minute seeds or sporules of the fungi that produce blights and mildews, float about in the atmosphere in countless myriads, only waiting for the presence of a fitting soil on which to alight and grow; and it has occurred to me, that the *Diptera* with their microscopic eyes may be employed to lessen the number of these sporules; they certainly do seem, as Emma says, to be darting after prey.

MR. B.

The thought has occurred also to me; but as I do not remember to have met with a supposition of the kind from any naturalist, I have hardly ventured to suggest it. Should it be proved that the clouds of flies and gnats that

“Sport together in the solar beam,”

are actually engaged in thinning the ranks of those vegetable legions that bring mildew, blight, and famine in their train, it will afford additional evidence of the wise economy which the God of nature exercises in his works. I am certainly inclined to think that some of the *Diptera* are so employed: their motions and evolutions have more the appearance of business than of sport.

It is very interesting, as Emma just now observed, to watch insects of this order on the wing. The gnat (*Culex pipiens*) sailing along in different directions, upwards, downwards, obliquely, with a motion of the wings so rapid as to be imperceptible; the slender crane-fly stretching out its arms and hind-legs, the one forming the prow and the other the stern of the vessel in its voyage through the ocean of air; and the fly tribes (*Muscidæ*) sometimes remaining for a moment stationary, and then darting along with the celerity and directness of an arrow.

FREDERICK.

You have told us the rate of speed at which some flies can run,—has that of their flight been estimated?

MR. B.

I have met with a calculation respecting the flight of the common fly (*Musca domestica*.) It is said that it usually makes with its wings six hundred strokes, which carry it five feet, every second; but that, if alarmed, its velocity can be increased six or seven fold, or to thirty or thirty-five feet, in the same period.

FREDERICK.

Astonishing! Why the celebrated race-horse Childers, which went at the rate of more than a mile in a minute, cleared only ninety feet in a second;—this little creature then can actually traverse in the same length of time one-third the distance of the most rapid race-horse!

MR. B.

Did it equal the race-horse in size, retaining its present powers in the ratio of its magnitude, it would speed over the globe with the rapidity of lightning.

Another particular to which I intended to direct your attention this evening is the *clothing* of insects, especially of the *Lepidoptera*.

FREDERICK.

I never observed that any others have clothing.

MR. B.

All whose wings are not defended by a case, have some protective or ornamental covering. Pass your finger over the wing of this dragon-fly, do you not perceive that the longitudinal nervures are set with very minute bristles, pointing towards the extremity? The darkening which you may observe in the point of the wing of the humble-bee,

is occasioned by a large number of hairs which seem to spring from a minute tubercle. In the common gnat, when the wings have not been rubbed, you may perceive that the nervures are adorned by a double series of scales, and that a fringe of them also ornaments the margin.

The wings of the *Lepidoptera* are, however, by far the most gorgeously adorned. They are covered, as you are aware, with an infinite number of minute plumes or scales, so thickly planted in their upper and under surface as for the most part entirely to conceal the membrane. These scales, which at first view resemble dust, give to the insect the colours with which it is adorned. Scrape a little piece of this nettle-butterfly's wing lightly with a pen-knife and put it into the microscope, and you will easily trace the lines in which they were planted.* You have left, you see, a few on, which will shew you the manner of their insertion. I must remark, however, that though in some species the scales are arranged with great regularity, in others they are placed without any order. Their number is immense. The patient Leeuwenhoek counted

* Plate I. Fig. 8.

more than four hundred thousand of them on the wings of a silk-worm moth; and in many larger species, they must be even far more numerous. I have here outlines of some* highly-magnified, by which you may see that they vary greatly in form as well as in arrangement.

FREDERICK.

How wonderful that there should be such variety in the habiliments, and that so much pains should be taken with the attire of even a butterfly!

EMMA.

Really, Papa, now I know how wonderfully formed and beautifully adorned insects are, I do not think I can ever bring myself to destroy one again.

MR. B.

I hope, my love, you will never kill one without a sufficient reason; but you must not indulge in undue sentimentalism on this subject.

FREDERICK.

I have often thought that I should like to make a collection of insects; but I have felt a little as Emma does:—I have not liked to kill them.

* Plate I. Fig. 11.

MR. B.

If they are killed in a proper manner I do not apprehend that the mere loss of life occasions them pain.

FREDERICK.

You do not think then with our great poet, that

—————“The poor beetle that we tread upon,
In corporal sufferance finds a pang as great,
As when a giant dies.”—

MR. B.

No: observations are all against such a supposition. The unconcern they manifest at the loss of their limbs, sufficiently proves that the pain they suffer cannot be very acute. A crane-fly (*Tipula*,) as Mr. Kirby remarks, will leave half its legs in the hands of an unlucky boy, who has endeavoured to catch it, and will fly here and there with as much agility and indifference as if nothing had happened; and an insect impaled upon a pin will often devour its prey with as much avidity as when at liberty. Mr. K. says that he has seen the common cock-chaffer move about with apparent unconcern after some bird had nearly emptied its body of the viscera; and

an ant walk when it had lost its head. A humble-bee will eat honey greedily, though deprived of its abdomen; and the head of a wasp will attempt to bite, and the abdomen to sting, after separation from the rest of the body. These facts sufficiently prove that insects do not possess that irritability of nerve, and capability of pain, which are possessed by higher orders of animals.

FREDERICK.

But there are other difficulties in the way of making a collection:—it is difficult to catch insects; and when they are caught, it is difficult to kill them without crushing them.

MR. B.

A little adroitness is certainly required to catch them. For the *Lepidoptera* and other flying insects, you should have a net, made of gauze or coarse muslin, fixed to two rods about four feet long, and so contrived, that you can draw it together in a moment, and secure your captive. For catching *Diptera* and *Hymenoptera*, when they alight on the leaves of plants and flowers, a kind of forceps is very useful. You may make it of an old pair of curling irons, by fixing to the ends octagonal brass hoops about six inches in

diameter, covered with catgut or green gauze. With such an instrument, you may indeed take almost any insect that is for a moment stationary. The gauze should be sufficiently coarse to admit the head of a pin through the interstices, as it is sometimes necessary to transfix your victim before you attempt to take it out. Many beetles and moths may be easily taken, during their season of repose, by the hand. You may gather the leaf with the moth on, and quickly shut up leaf and moth together in a little tin box, with several of which you should be provided for the purpose.

EMMA.

You speak of their season of repose:—do you mean that insects are sometimes to be found asleep?

MR. B.

I do not mean to assert that they sleep as we do; they cannot shut their eyes, for they have no eyelids; but from the fact that at certain intervals of the day or night they withdraw for a time from activity and observation, it is natural to conclude that during those intervals they resign themselves to a state of oblivious repose. You may indeed often find them in this state; I have seen

the cock-chafer which, as you know, flies only in the evening, roosting in a tree during the day, still and motionless, with his antennæ folded to the breast; and I have often found moths on the north side of the trunk of a tree, perched on the lichens, with their wings and antennæ folded, and themselves without motion, and perfectly insensible of the approach of my hand to capture them. Huber states with regard to bees, that he has frequently seen them when apparently wearied with exertion, even in the middle of the day, insert the half of their bodies into an empty cell, and remain there, as if taking a nap, for half an hour or more. At night, as you may observe, the whole hive regularly assumes a state of sleep-like silence. It seems pretty evident, therefore, from these and from other facts that might be adduced, that insects have their periods of rest analogous, at least, to sleep; and if you can discover them during these periods, they may very easily be taken.

FREDERICK.

But then the *killing*, Father;—that seems the most difficult part of the affair. Killing them, I mean, so as not at all to injure their beauty.

MR. B.

I have generally found immersing them in spirits of wine the easiest and most certain plan. When you go on your entomological researches, you should take with you a small wide-mouthed bottle full of this liquid, and as you catch your insects, put them in. They will soon be dead; and you may put all sorts and sizes together, without fear of their devouring each other. When you come home, strain your spirits of wine through a piece of muslin, return them to the bottle for future use, and lay your insects on blotting paper to dry. Spirits of wine, however, will not do for the *Lepidoptera*; you must expose them to the action of heat; a low degree of which will be sufficient. Those you have in tin boxes, you may immerse in a basin of boiling water. Another good way of killing some insects that you do not wish to wet, is to impale them on a piece of elder, or some other soft wood which you have fixed tightly at the bottom of a jar; and then, having inverted the jar in a deep basin, to pour in boiling water till it is covered; taking care, of course, to hold it down, so that the expansion of the included air may not overturn

it. In two minutes or less, the insect will be found quite dead, and not at all wetted.

When you have killed your insects, the next thing is to set them. You must have for this purpose a thin piece of cork with white paper pasted upon it, and some lace-pins of various sizes; with one of these pins you must fix each insect on the cork, passing your pin through the back of butterflies and some others, and through the left-hand elytra of beetles, and taking care that the legs do not touch the cork. Then, with narrow slips of thin card, you must brace down the legs, wings, and antennæ, in the attitude most usually assumed by the living insect. Having done this, and taken care to secure your insects from the rapacity of earwigs, you must leave them for a few days exposed to the air to dry and stiffen. Some very small ones you will find it best to gum upon card; the attempt to pass a pin through them would probably quite destroy their beauty.

Having completed the setting of your insects, and removed the braces, you must place them in your cabinet; the drawers and cases of which should be about an inch and a half, or two inches deep, and covered with glass; and together with

them put in a little piece of camphor, to preserve them from the attacks of mites and other insect depredators. I should advise you first to arrange your specimens simply with reference to the orders to which they belong; as you become more practised in distinctions, you will easily separate them further according to their respective families, genera, subgenera, and species. You will bear in mind that by far the most numerous order, amounting to at least one half of the whole insect world, is the *Coleoptera*; and next to this, the *Lepidoptera* and the *Hymenoptera*.

Being now in some measure acquainted with the physical history of insects, you will follow them, I hope, with increased pleasure and interest into the field, the garden, and the forest, to inquire more particularly into the employments and social economy of these free-born denizens of earth and air.

EMMA.

You said, I remember, that among insects were to be found the first geometricians and architects; the first weavers and spinners; the first paper-makers and fabricators of diving-bells and air-pumps; indeed, the first practisers of several arts of which the invention is the boast of modern times.

MR. B.

As we proceed, I hope to have the pleasure of introducing these little mechanics to your notice; and of proving to you their claims to precedence in the several arts they are found to practise.

SEVENTH EVENING.

Spiders :—particulars in which they differ from insects.—
Remarkable for their ingenuity in capturing their prey.—
Eyes, legs, mouth.—Not injurious to man.—Spiders
an article of food.—Their apparatus for swimming.—
Mode of weaving of the garden-spider ;—of the house-
spider.—Spiders air-balloonists.—Gossamer webs.—
Spider-silk.—Trap-door spiders.—Diving spiders.

I am looking forward with high expectations to this evening, Papa, said Emma as she met her parents in one of the walks of the shrubbery.

MR. B.

You are thinking of the little primitive artisans to which I have engaged to introduce you.

Well, if it will be agreeable to Mamma, suppose we all take our seat in this arbour, and begin our evening's entertainment at once. I see a member of one of the most skilful of the insect tribes, watching the web which he has woven between the boughs of the clematis : I do not know that we could have a better subject.

EMMA.

But I thought, Papa, you did not reckon spiders among insects.

MR. B.

They differ in so many particulars from other insects that naturalists have placed them, with some others, in a class by themselves, called, as I have told you, *Arachnidæ*; but still, they have so many points of resemblance to insects in general, as well as connection with them, that no account of the insect world can be considered complete which does not include them.

FREDERICK.

In what particulars do spiders differ so much from other insects, Father?

MR. B.

Insects, you know, have no circulation of fluids: spiders have; their heart and blood-vessels are clearly perceptible; and in consequence they do not breathe through spiracles in the sides as insects do, but have organs that answer the purpose of lungs. In insects, the head is united to the body by means of slender threads: in spiders it is joined immediately to it. Insects, all *hexapod* insects at least, have two compound eyes: spiders have simple eyes more resembling the organs of vision in the higher orders of animals. Insects have only six legs: spiders when they have attained

to maturity have eight. Spiders also have no *antennæ* which, as you know, form an important part of the insect's structure.

The natural history of spiders is highly interesting, not only with regard to their physiology, but also to the wonderful instincts displayed by the different species in the construction of their webs, and the surprise and destruction of their victims. No sagacity exhibited by the higher orders of animals, not excepting even that of the "half-reasoning beaver," is at all equal to the skill displayed by spiders in forming their habitations and capturing their prey. Some bore tunnels for themselves in wood, earth, or any other penetrable substance, lining them with a silken tapestry of most beautiful texture adapted to resist humidity, and actually guarding the entrance by a trap-door. Others, of which we have a specimen before us, make large nets of the most regular conformation and curious fabric, near which the little fowler lies completely hidden from view, "making semblance," as a quaint writer remarks, "as though he meant nothing less than that he doth, and as if he went about some other business! nay, so close lieth he, that it is

impossible to see whether any one be within or no," until warned of the neighbourhood of his game by a line passing from the centre of the web to his place of concealment, he darts forth and attacks the unfortunate victim entangled in his toils. Others, that may be termed *hunters*, neither dig dens nor form nets; but conceal themselves within a flower or a rolled-up leaf, or behind a stone, and dart upon any insect that chances to pass; while others employ various stratagems to decoy their victims, such as pretending to be dead; and others, possessing peculiar agility, openly search after and seize their prey, springing upon it with the precision and ferocity of a tiger. One of these has been seen to spring upon a humble bee at a distance of two feet.

MRS. B.

Spiders appear to be to the insect world, what beasts of prey are to quadrupeds.

MR. B.

They very much resemble them. They are equally solitary and ferocious in their habits; like them they live entirely by prey, and like them too they hunt chiefly by night.

I have a good magnifying glass in my pocket;

and while this spider is quietly watching his web, we will examine him through it.

EMMA.

How beautiful his skin appears ! it looks like a hard polished crust.

MR. B.

You perceive that he has eight eyes on the top of the head. This number of eyes is common with few exceptions to all spiders ; but they are differently placed in the different species. In some, they lie in two rows ; in others, they form two sides of an angle ; indeed, they assume every imaginable difference of position. It is chiefly by the arrangement of the eyes that the different species are distinguished.

EMMA.

Are there many different species ?

MR. B.

Naturalists have enumerated upwards of fifty.

FREDERICK.

Do spiders undergo any essential change in their progress to maturity ?

MR. B.

Yes, in common with all articulated animals, they cast the outer skin several times and at stated

periods ; and in the earlier stages of their existence they have a smaller number of legs : the last pair do not make their appearance until the spider has attained a certain size.

I was going to shew you this spider's mouth. It is furnished with two fangs, each terminating in a sharp talon, which stand out horizontally, and when not in use, are concealed in two cases contrived for their reception, into which they fold like a clasp knife. Each fang has at the point a minute aperture, through which, when the victim is lacerated, a poisonous fluid is emitted that quickly dispatches it.

FREDERICK.

His legs also seem admirably well adapted for sanguinary encounters.

MR. B.

They have each, you see, three joints, and terminate in two crooked claws, with a smaller one, something like a spur, between them. Every thing, indeed, in the structure of spiders points them out to be most ferocious little animals ; and their habits do not contradict the inference we draw from their appearance. They attack and devour not only other insects, but each other ;

and that without mercy. Even the female does not spare her mate, unless he speedily make his escape out of her clutches.

EMMA.

Then, Papa, it is not without reason that people are afraid of spiders.

MR. B.

You mean, Emma, that *insects* are afraid of them. I never heard of a spider, however fierce and treacherous, killing and eating a man. They take pretty good care not to come near enough to do us any injury, even if they had the power to do it. If you approach one, and he is aware of you, he will run off as fast as he can; and if he find he cannot otherwise escape, he will fall down, curl up his legs, and assume the appearance of death. Depend upon it, a spider will never engage in the unequal warfare.

FREDERICK.

Do you mean to say, Father, that spiders never injure us?

MR. B.,

I do not mean positively to say that; there may be, and probably there are, in warm countries, individual species whose bite is poisonous, but in

very few, I apprehend, to a fatal extent. With regard to those in our latitude, M. Köllar, the distinguished German entomologist, says, that he had caught in his hand most of the native species without receiving the least injury from them ; and that he had once been bitten by one, but that the bite produced no inflammation, and the pain of it passed away without the application of any remedy. Spiders, like other creatures, when persecuted and captured, will of course bite to defend themselves.

FREDERICK.

Is not the bite of the *tarantula* frequently fatal ?

MR. B.

O ! no. Sad tales are related of its death-dealing powers ; but it is now pretty clearly proved that these pretended effects were a long practised cheat put upon credulous travellers.

There is, I believe, a species of spider found in Popayan, of a fiery red colour, called by the natives *Coya*, the juices of whose body when crushed, are extremely venomous ; but these spiders, like our own, are perfectly harmless while living. The Indians are wisely careful not to crush them.

Mrs. B.

I have read of a woman being much injured by the juices of spiders in our own country ; but then the silly cruel creature had only herself to thank for it. It was her custom, every time she went into the cellar with a candle, to burn all the cobwebs and spiders she could see. She had often felt dizzy and faint from the smell of the burning spiders, but nothing could cure her inhumanity till one day the legs of one of her unfortunate victims happening to stick in the candle, so that it could not disengage itself, the body burst in the flame ; and the contents of it being thrown upon her eyes and lips, caused such swelling and inflammation that it was several weeks before she recovered.

FREDERICK.

The stupid old woman was rightly served.

Mrs. B.

The dislike many people feel to spiders lies, I am persuaded, rather in prejudice than in any conviction of their disposition to hurt us. For my own part, I have been so long in the habit of admiring the skill, the patience, and the persevering industry of these so generally-hated little

creatures, that a spider is to me an attractive rather than a repulsive object.

FREDERICK.

How should you like to eat spiders, Emma?

EMMA.

O Frederick! how can you mention such a thing!

FREDERICK.

Some people eat them, I assure you. Labillardiere tells us, that there is a spider in New Caledonia, nearly an inch long, which the inhabitants collect in large quantities, roast over the fire, and eat with great relish. Some of the inhabitants of South Africa also reckon spiders among their dainties.

EMMA.

Spiders may be very suitable dainties for the inhabitants of New Caledonia and the savage Bushmen. They will eat anything.

MR. B.

Spiders have been considered dainties, Emma, even in civilized life, and among literary persons. That female of singular talents, the celebrated Anna Maria Schurman, used to eat them like nuts; which she said they very much resembled

in taste; and Reaumur tells us of another young lady who could never resist the temptation of such a *bon bon* as a garden-spider. Lalande, the French astronomer, was also very fond of their flavour; and Röscl mentions a German who used to spread them on his bread like butter.—But enough of spider-eating; we will turn to some more agreeable subject.

The apparatus for spinning, with which spiders are furnished, is a curious part of their mechanism. It consists of four or six little tubercles at the end of the abdomen, each of which contains a multitude of tubes, so numerous and so exquisitely fine, that a space, often not bigger than the point of a pin, is furnished, according to Reaumur, with a thousand of them. From each of these minute tubes the spider emits a glutinous silky thread of inconceivable tenuity; the threads from them all uniting together, form that which they employ in weaving their webs.

EMMA.

Then each spider's thread that is visible to us is formed of four or perhaps six thousand others!

MR. B.

Yes: even those of the smallest species, some

of which, you know, are so fine as to be almost imperceptible to us, are in reality ropes, composed of at least four thousand strands.

EMMA.

And these complicated threads are not after all so thick as a hair!

MR. B.

So thick as a hair! my dear;—a thousand of them would scarcely form one so thick as a hair of your head.

The manner in which spiders employ this thread is, as I just now said, a sufficient proof that they possess superior instinctive intelligence.

When the spider begins to form his web, (I speak now more particularly of the garden-spider, *Epeira diadema*, because we have one before us,) he first fixes the end of his thread by applying his spinners to anything that happens to be convenient; and the thread lengthening in proportion as he recedes from the point where he had fixed it, he fastens it again to something on the opposite side. In this way he forms the margin of his net, which he takes special care to render strong by gluing several threads together. The construction of this margin appears to be the most important and difficult part of the operation;

when this is done, he quickly crosses the area he has described by the radiating lines, which give it a wheel-like appearance. These radii, which are generally about twenty in number, being finished, he goes to the centre, and tests their strength by pulling each thread with his feet; if any appear weak or defective, he breaks them, and supplies their place with others.

Having thus formed the foundation of his web, he attaches around the centre five or six small concentric circles; and then, at greater distances, four or five larger ones, which are intended to serve as a sort of temporary scaffolding, and also to keep the radii properly stretched, while he glues to them the viscid threads intended to ensnare his victims. This done, he runs again to the centre, bites away the small cotton-like tuft that unites the radii, and in the circular opening thus produced, takes his station, and watches for his prey.

Dryden beautifully describes his proceedings when his web is finished.

“The treacherous spider, when his nets are spread,
Deep ambushed in his silent den doth lie,
And feels, far off, the trembling of his thread,
Whose filmy cord should bind the struggling fly;

Then, if at last he find him fast beset,
He issues forth, and runs along his loom,
Eager to seize the captive in his net,
And drag the little wretch in triumph home."

FREDERICK.

The formation of his net must be a long process.

MR. B.

No, it is not; indeed it cannot be; for when it is not destroyed by any accident, such as some great unmanageable insect perversely entangling itself in the threads, he renews it partially, if not entirely, every twenty-four hours; for the circles more especially designed to catch his prey, are composed of a peculiarly viscid material, which, when long exposed to the air, dries and loses its adhesive property.

EMMA.

But I have seen what appeared to me the same cobweb hanging for months in the same place.

MR. B.

Very likely you have. The web of the house-spider, which is a gauze-like substance, formed to entrap the claws of flies in its fine meshes, will serve, with occasional repairs, for a considerable period.

Do you know, I expect a continuance of fine weather from the appearance of this spider's web.

MRS. B.

What do you judge from?

MR. B.

From the great length of the main threads which support it. Spiders are very dependant for success on weather; the web of many an one is destroyed by a storm of wind or a heavy shower, and as long as rain or wind continues, they must fast, though it be for weeks or months, for the web cannot be renewed. Availing themselves, therefore, of every possible precaution against the destruction of their webs, it has been observed that if the weather is about to be changeable, wet, or stormy, they make the foundation threads short, that they may not so easily be broken; but that if fine settled weather be on the point of commencing, they venture to extend their toils by making these threads long.

FREDERICK.

I have often wondered how they spin those long threads; I mean how they contrive to get across with the first thread; for the point to which they ultimately fasten it is often a very

long way, sometimes a yard or more, from that where they begun. There is nothing for them to walk on, and they cannot fly.

MR. B.

Spiders appear to have the power of darting their threads before them in any direction, and to almost any extent they please. Having fixed the thread, therefore, at one point, they throw it out towards some other, where they design to fasten it, judging, we know not how, of its position and distance.

MRS. B.

And they have, I believe, the power of throwing out their threads not only in a horizontal direction, but up into the air; in fact, of forming for themselves air-balloons of them.

MR. B.

Yes: the invention of Montgolfier has always been in the possession of spiders. Naturalists, who have paid attention to this interesting fact, have observed that when a spider purposes an aërial excursion, he throws himself upon his back, darts out a long thread, and vaults from the place on which he stood. As he ascends, he pulls in his thread with his fore-feet, so as to

form it into a ball of flake, and thus increasing his surface without increasing his gravity, he sometimes soars away to a prodigious elevation. Dr. Martin Lister, a curious observer of these little animals, states that he once saw from the top of the highest steeple of York Minster, numbers of these webs floating still very high above him.

FREDERICK.

Is this faculty common to all spiders, or only to some particular species?

MR. B.

It does not appear to be confined to any one species. It is only, however, in their young or half-grown state that they have been observed to make these aëronautical expeditions; from whence we may infer that when full grown, their bodies are too large and heavy.

The fleecy webs thus spun in the air, as well as those we sometimes see in fine autumnal mornings spread in such profusion over fields of stubble, form what in our country are called *gossamer* webs; the French call them *fil de la vierge*; and the Germans, from their constantly appearing in the autumn, *der fliegender sommer*, the flying or departing summer.

EMMA.

I suppose the material of which spiders form their threads is of the same nature as the silk spun by the silk-worm and other caterpillars.

MR. B.

Yes, it is; and a Frenchman once speculated on the possibility of employing it to a useful purpose. He contrived to manufacture from the bags or cones which the female spins for the reception of her eggs, (and which you have often seen, I dare say, like little yellow silken balls safely fixed in secure corners,) a pair of silk stockings and mittens. But he found it would be impossible to carry on the manufacture to any extent; for the work of twelve spiders is not equal to more than that of one silk-worm; and their ferocity is so great that they cannot be prevented from destroying one another.

MRS. B.

I have heard that the spiders of the Bermudas spin webs between trees forty or fifty feet distant, and strong enough to ensnare a bird as large as a thrush.

MR. B.

Where large insects are to be caught, there the

spider is instructed to form his web of corresponding size and strength. Sir G. Staunton informs us, that in the forests of Java also, spiders' webs are to be found so remarkably thick and tenacious as to require a sharp knife to divide them.

EMMA.

I think, you said, Papa, that there are some spiders that do not spin webs.

MR. B.

Many species do not; but devote their silken stores chiefly to the service of their young. All spiders lay their eggs carefully in silken cones; for they are tender, affectionate parents.

Among those spiders that do not spin webs, two species are especially deserving to be placed among our primitive mechanics;—the *trap-door* spiders, as they are called, and the fabricators of the *diving-bell*.

EMMA.

I was wishing to ask you, Papa, about the *den* and the *trap-door* you mentioned.

MR. B.

There are, I believe, two or three varieties of the *trap-door* spider. That whose habitation I have seen, (*Cteniza cæmentaria*,) is found in

the south of France. This sagacious little creature first digs by means of his strong jaws, a cylindrical gallery or tunnel, upwards of two feet long and about half an inch in diameter; selecting for the purpose a steep bank of bare clay from which the rain will readily run off. Having excavated the tunnel, he lines it throughout with a web of fine silk; this serves the double purpose of strengthening the walls and of forming such a communication with the door as may inform him of what is passing above.

EMMA.

The *door* is what I am particularly curious to hear about.—You do not mean a *real* door, Papa, do you?

MR. B.

Yes, my dear: I do. This spider forms a real door; not of wood, but of several layers of clay or chalk cemented together with silk. When finished it is as perfectly circular as if it were traced with compasses; and fits so nicely into the aperture of the cell, that the casual observer cannot distinguish it from the surrounding earth. But the most marvellous circumstance is, that the clever little architect actually fixes it to the entrance by a *hinge*

of silk ; and as if acquainted with mechanical laws, invariably places the hinge at the *highest* side of the opening ; so that the door, which is easily pushed open by the spider from within, shuts again by its own weight ; and there being a little edge, or groove, to receive it, it closes with such precision, that, as I said, it seems to make one surface with the earth in which it is formed. If any attempt be made from without to open it, the courageous little inhabitant, warned by the vibration of the threads which extend to the bottom of the gallery, runs to it with all speed, and fastening his claws on one side to the door and on the other to the walls of his den, pulls with all his might against the intruder.

Thus skilfully formed and defended, this curious subterranean furnishes a secure habitation for the spider and his family ; which usually consists of his mate and twenty or thirty young ones. At night, they prowl about in search of prey ; chiefly beetles ; which they drag into their den and devour. The bottom of it is usually strewed with the remains of various *coleopterous* insects.

The fabricator of the *diving bell*, (*Argyroneta aquatica*) is a water-spider, and one of the largest of the spider-race.

EMMA.

That I suppose was the insect you alluded to as the first employer of a diving-bell. But how is it possible, Papa, for the little creature to form such a machine and to lower it into the water ?

MR. B.

She does not first form it and then lower it into the water, Emma : I did not mean to say that. She does what would puzzle our engineers far more ; she actually builds it *in* the water. She first forms the frame-work of loose threads attached to the leaves of aquatic plants. These threads she varnishes over with a glutinous transparent secretion resembling liquid glass, and so elastic as to admit of considerable distension and contraction. Having thus formed the *bell*, she spreads over her body a pellicle of the same secretion ; and ascending to the surface, obtains, though in what manner is not exactly known, a bubble of air. Surrounded with this aërial mantle, which to the spectator seems formed of brilliant quicksilver, she plunges to the bottom, and introduces the bubble of air beneath the roof of her habitation. This process she repeats ten or twelve times ; till, in about a quarter of an hour, having conveyed as much

air as suffices to extend her dwelling to its proposed dimensions, she finds herself in possession of a little aërial edifice formed in the very midst of the waters. Here she dwells: and from this curious chamber, which is about the size and shape of half a pigeon's egg, she issues forth, searching sometimes the water, and sometimes the land, for prey; which, when obtained, is transported to this submarine mansion, and devoured at leisure. Both sexes form these lodgings; but early in the spring, the male quits his own and seeks that of the female, which being enlarged by a bubble of air that he brought with him, becomes the abode of the happy pair, and a safe depository for their eggs; treasures which are packed up in a silken cocoon in one corner of their dwelling and carefully watched over by the mother. This spider, in some countries, is not uncommon in stagnant pools.

But the dews of evening are beginning to fall, and to remind us that it is time to return to the house.

I shall henceforth look at spiders with feelings very different from those I used to have, said Emma, as they arose to leave the harbour. I see

now the force and beauty of Solomon's remark, that "though little upon earth, they are exceeding wise."

And exceedingly useful too, rejoined Mr. B. We owe much to their exertions, and ought to regard them with complacency and pleasure.

EIGHTH EVENING.

Pleasure to be derived from an acquaintance with nature.—Food of insects.—Vegetable-eating insects;—select different plants and different parts of plants;—wisdom of this arrangement.—Insects confer benefits on vegetation.—The chief cultivators of uninhabited lands.—Useful in the fertilization of plants; in pruning them of their redundant fruit and leaves; in loosening the soil around their roots.—The agency of insects valuable in forests.—Locusts; their occasional but fearful ravages.—Mrs. Howitt's description of the locust; that of the prophet Joel.—Locusts serviceable within their native boundaries; frequently visit Africa; sometimes lay waste parts of Europe; have appeared in our own island: Dr. Clarke's account of the different kinds of locusts.—Termites: great injuries sometimes sustained from their voracity; benefits they confer on tropical countries; manner of their operations.—Timber-eating insects in our own country.—Benefits conferred by insects on literature and the arts: galls; oak-apples; rose-willow; bedeguar; lac; kermes; cochineal; Influence of insects on commerce: silk; honey; wax; Chinese wax.—Insects once used in medicine.—Some useful in the present day: Ant lint; cantharides.—Insects employed as food: various larvæ.—Locusts extensively eaten

in Africa and the East.—Termites, a favourite dish with the Hottentots and Hindoos.—Galls used as dessert.—Lemonade prepared from ants.—The acid of ants caused by the nature of their food.

I have been thinking Papa, said Emma, in connection with our late agreeable evenings, how much enjoyment we lose through ignorance. I never before this vacation looked at insects with any thing like interest; now it is always a real treat to me to watch one.

MR. B.

Your remark, my dear Emma, is just. The volume of nature presents in varied profusion much that is curious, instructive, and beautiful; but we must learn to read it before we can derive the pleasure it is designed to yield. When, however, we are even in a small degree acquainted with its contents, we find that objects apparently the most trivial, a mere stone, a humble weed, or a busy insect, will often suggest trains of delightful contemplation, and afford us enjoyment of the purest kind. On the ground of pleasure, therefore, apart from the immediate benefit connected with a knowledge of the structure and properties of the objects by which we are surround-

ed, I advise all young persons to cultivate an intimate and practical acquaintance with the works of God. As our favorite poet says :—

“Tis sweet to muse upon His skill display’d
(Infinite skill) in all that he has made !
To trace, in Nature’s most minute design,
The signature and stamp of power divine.”

We are now to enter a little more at large on the general history of insects. First, we shall consider them in relation to other parts of nature, and especially to ourselves; and then we shall take a glance at their habitations and social economy, which will include their modes of defence, their luminous and musical powers, and various other interesting and amusing particulars.

EMMA.

Really, Papa, you make me smile : I should almost think you were speaking of rational beings.

MR. B.

Several of the facts to which I shall refer will convince you that, as I have before remarked, the instinctive sagacity displayed by many insects more nearly resembles reason than that of most other irrational animals. Solomon, whose deep and comprehensive mind grasped the whole crea-

tion, and accurately discerned the place and properties of all its various parts, repeatedly sends us, you know, to the insect world to learn *wisdom*.

As it is chiefly in providing for themselves or their young that this sagacity is manifested, we will look, in the first place, at their food ; in their pursuit of which, their relation to other departments of nature, and to ourselves, is principally exhibited.

FREDERICK.

I know by experience that they are sagacious enough about food. I am generally quite puzzled to feed those I find, if I do not happen to discover them on the identical substance they prefer. Many will die of starvation rather than eat what I give them.

EMMA.

What is become of the glow-worms you brought home the other night, Frederick ?

FREDERICK.

I rather think they are all dead. They would not touch any of the leaves I offered them.

MR. B.

You should have given them some snails or slugs. Carnivorous insects will not eat leaves any more than carnivorous beasts.

In the choice of food, insects have a much more extensive variety open to them than any other class of animals, perhaps I might say, than all other classes together; for their immense strength and agility, combined with the minuteness of their forms, enable them to force their way into almost every substance, and to feast at pleasure on things inaccessible to all besides. The whole organic creation may indeed be considered as a stupendous table, at which the insect world sit down as guests, and at which no viand is left untasted by some or other of the numerous company.

Some of these guests are exclusively vegetable eaters; others confine themselves to animal substances; while a very great number live at one period of their existence on animal, and at another, on vegetable diet; and a few will eat anything that comes in their way. Among all these classes, some prefer their food in a dead, and even in a decayed state; and others will eat it only when alive or fresh: some can live only on one kind of plant or animal, while others, and that a large proportion of species, are able to subsist on several kinds.

Of *phytophagous* insects, or those that feed on

vegetables, very few, even of those that are not confined to one particular species, eat of all plants indiscriminately, or of all the parts of the same plant. Those that live under ground, among which are the larvæ of several of the beetle tribes, find the roots most accessible, as well as most to their taste. Others prefer the stem and branches. A third division, more open in their depredations, live exclusively on the leaves. A fourth select the flowers. While a fifth choose the more substantial fruit or seed. Even among each of these a still further selection takes place.

Of those that feed on the roots, or stem and branches, some, as the bee-hawkmoth, (*Sphinx epiformis*,) eat only the rind; others, only the inner bark and alburnum; a third, and still larger party, consisting of the stag-beetle tribes, (*Lucanidæ*,) some of the weevils, the capricorn-beetles, (*Cerambycidæ*,) and the only larva among the *Lepidoptera* that feeds on wood, the great goat-moth, (hence called *Cossus ligniperda*,) with a few others, penetrate even into the solid heart of the tree.

Of those that choose the leaves, the various kinds of *Aphides*, or plant-lice, take only the juice

from the veins; the mining caterpillars only the *parenchyma* or fleshy substance between the cuticles: I dare say you have often seen the leaves of the bramble, the dandelion, and other plants, thus excavated, and looking almost as if they had been *tattooed*: many of the leaf-rolling caterpillars take only the lower surface of the leaf; while the more rapacious larvæ of most lepidopterous insects greedily devour it entire.

Among those whose more delicate taste leads them to prefer the flowers, some, as the mullein moth, select the petals; others, as the rose-chafers, &c., the farina in a perfect state; bees also collect the farina to make of it *bee-bread* for themselves and their young; and a still greater number, among which are wasps and flies, with most butterflies and moths, revel on the honey in the nectaries. I need not add that from this bees elaborate their delicious stores.

Mrs. B.

We cannot fail to admire the wise economy that thus regulates the preferences of insects. Had all eaten exclusively of the roots, of the stem and branches, of the leaves or of the flowers, the whole vegetable world would perhaps have

perished, or some at least of its productions would have become extinct in consequence of their depredations; but by this arrangement so little of each part is usually taken, that while the wants of insects are fully satisfied, vegetation, generally speaking, sustains no injury.

MR. B.

So far from sustaining injury, it is greatly indebted to insects for its fertility and beauty. Though they are sometimes permitted to exceed the boundary which the God of nature has assigned to them, and to prove to us what they could do if a watchful providence did not control their operations, they deserve to be regarded, in general, as the conservators of the vegetable creation. They dig and prune where human foot has never trod, and preserve the virgin soil of many an unexplored region in a state of rich and verdant cultivation, adapted to supply the wants of the numerous wild animals that range over it, and ready for the hand of man when he arrives to take possession.

Even in cultivated lands, the benefits insects confer, greatly exceed in amount the injuries of which we sometimes so loudly complain.

In many plants, particularly those of the Linnean classes, *Monoecia*, *Dioecia* and *Polygamia*, in which the stamens are in one blossom and the pistils in another, their agency in conveying the fertilizing pollen from the anthers to the germen, is essential to the production of fruit.

Insects that attack our embryo fruits, or crop the luxuriant foliage of the trees, do us much service both by preventing an over growth of fruit, and by rendering its leafy covering more pervious to the air and sun. They do indeed just what the skilful gardener often does when he thins the fruit and prunes the leaves, that the tree may not be exhausted by too large a crop, and that the fruit which is left may be of finer quality.

Even the burrowing insects, though when too numerous they do injury to our meadows and corn-fields, are of essential service by loosening the soil, and thereby enabling the young roots to shoot with greater ease.

The agency of insects is also very important in forests, especially in the immense ones of tropical climates. When symptoms of decay among the veteran trees become apparent, their united service

are soon employed to prevent them from long remaining a nuisance. A host of caterpillars take possession of the branches and consume the foliage. Another host of insects bore through the rind and pierce and destroy the inner bark; and a third, and still more numerous class, finally accomplish the dissolution of the dying trees by reducing the decayed wood to dust.

Thus we find that, on the one hand, insects promote the strength and fruitfulness of plants, and on the other, that they present a constant and effectual check both to a too great exuberance of vegetation, and to an accumulation of decaying vegetable matter. They seem, indeed, to have it in charge to preserve the face of nature in youthful beauty and vigour.

There are two species of phytiphagous insects which in this connection deserve especial notice: —Locusts and Termites.

FREDERICK.

I have always regarded locusts as among the most dreadful of invaders; as vieing indeed with human desolators in their ability to ravage and destroy.

MR. B.

And such is their character when, commissioned by God, they leave their native boundaries. No visitation is more to be feared than

—————“ A pitchy cloud
Of locusts warping on the eastern wind.”

The swarms in which they fly often measure several hundred fathoms in diameter and many miles in extent, so that in passing they thoroughly hide the sun, and produce a darkness as great as that of a total eclipse. These swarms are sometimes so vast as to be three or four hours in flying over a particular spot. Southey strikingly describes their progress in his *Thalaba* :—

“ Onward they came, a dark, continuous cloud
Of congregated myriads numberless,
The rushing of whose wings was as the sound
Of a broad river, headlong in its course,
Plung’d from a mountain summit ; or the roar
Of a wild ocean in the autumn storm,
Shattering its billows on a shore of rocks.”

And when they arrive on cultivated lands it is awful to see the face of the country which but an hour before was smiling and joyous, entirely covered as with a living veil, extending as far as

the eye can reach, and perhaps for many hundreds of miles beyond :—the trees bending beneath the weight of their destroyers, and every atom of verdure rapidly disappearing. And then to hear the noise of their powerful jaws, like the sound of a flame of fire driven by the wind, as meadows, corn-fields, vineyards, orchards, and forests, are rapidly falling victims to their irresistible sway.

Nor is this all. The effluvium from the dead bodies of these countless myriads fills the air with impurity, and often produces pestilence of a fearful character. Mr. Barrow, speaking of their ravages in the southern part of Africa, towards the close of the last century, says that an area of nearly two thousand square miles was literally covered by them; and that when driven into the sea by the wind, they formed upon the shore for fifty miles a bank three or four feet high, the scent of which was so powerful as to be smelt, when the wind lay in the right direction, at a distance of a hundred and fifty miles.

EMMA.

You recal to my recollection Mrs. Howitt's description of the locust.

MR. B.

Will you favour us by reciting it ?

EMMA.

“ The locust is fierce, and strong, and grim,
And an armed man is afraid of him ;
He comes like a winged shape of dread,
With his shielded back and his armed head,
And his double wings, for hasty flight,
And a keen, unwearying appetite.

He comes with famine and fear along,
An army a million million strong ;
The Goth, and the Vandal, and dwarfish Hun,
With their swarming people, wild and dun,
Brought not the dread that the locust brings,
When is heard the rush of their myriad wings.

From the deserts of burning sand they speed,
Where the lions roam and the serpents breed ;
Far over the sea, away, away !
And they darken the sun at noon of day ;
Like Eden the land before they find,
But they leave it a desolate waste behind.

The peasant grows pale when he sees them come,
And standeth before them weak and dumb ;
For they come like a raging fire in power,
And eat up a harvest in half an hour ;
And the trees are bare, and the land is brown,
As if trampled and trod by an army down.

There is terror in every monarch's eye,
 When he hears that this terrible foe is nigh ;
 For he knows that the might of an armed host
 Cannot drive the spoiler from out his coast,
 That terror and famine his land await,
 And from north to south 'twill be desolate.

Thus the ravening locust is strong and grim,
 And what were an armed man to him ?
 Fire turneth him not, nor sea prevents,
 He is stronger by far than the elements !
 The broad green earth is his prostrate prey,
 And he darkens the sun at noon of day !”

MR. B.

Thank you. One or two lines put me in mind of a passage in the second chapter of Joel, in which the arrival and devastations of locusts are graphically and sublimely described :—“ A day of darkness and of gloominess, a day of clouds and of thick darkness, as the morning spread upon the mountains ; a great people and a strong :—a fire devoureth before them, and behind them a flame burneth : the land is as the garden of Eden before them ; and behind them a desolate wilderness ; yea, and nothing shall escape them.”

When locusts visit a country, they usually stay from three to seven years, and generally reduce it to a state of entire desolation.

Yet even locusts, fearful as are their visits to inhabited countries, do immense good within their native boundaries. Their home is in the deserts of Tartary and Arabia; and many a region in these and the neighbouring untrodden wastes, which but for them would be permanently choked up by shrubs, and hard, half-withered and unpalatable plants and grasses, being from time to time by their means disincumbered of its burden, and thoroughly laid bare, continually reappears clothed in a young and flowery herbage, whose juicy shoots afford delicious food for the numerous animals that tenant those solitary plains.

FREDERICK.

I suppose the countries adjacent to Arabia and Tartary are most exposed to the ravages of locusts.

MR. B.

Yes. The first mention we have of them is, as you will remember, in connection with Egypt.* Africa has always been peculiarly liable to these visitations; and from Africa locusts have not unfrequently passed over into different parts of Europe. Italy, Spain, France, Germany, and particularly Transylvania, have been repeatedly visited by these invaders.

* Exodus x, 12—14.

More than once they have appeared even in our island. In the year 1673 some alighted in Wales; and in the year 1748 considerable alarm was excited by swarms falling in various parts of England, particularly in the neighbourhood of London. Happily, however, they soon perished without propagating. These swarms were probably stragglers from the host which, the year before, had laid waste Transylvania and the neighbouring provinces.

Dr. Clarke, in his travels in Tartary, describes three species of locusts:—the *gryllus tartarius* and the *gryllus migratorius*, whose visit to the steppes of Tartary he witnessed, and the *gryllus viridissimus* found near the Don and the Khuban. The *gryllus tartarius* is a very large species; and from its usually appearing before the *gryllus migratorius*, is called the herald or messenger. The *gryllus migratorius*, or migratory locust, has red legs, and its inferior wings have, he informs us, a lively red colour, which gives a bright fiery appearance to the animal when fluttering in the sun's rays.

Termites, or white ants, are another class of insects endowed with peculiar powers either for good or evil.

Mrs. B.

Linné called them the great calamity of both the Indies.

Mr. B.

He did; but I think from taking a partial view of them; from looking at the mischief rather than at the good they do. Immense damage is often sustained, it is true, when they find their way into houses and stores, from their insatiable and undistinguishing voracity. Nothing less hard than glass or metal escapes the attacks of their omniverous jaws. In the course of one night, they frequently destroy all the furniture, and indeed all the timber-work of a spacious apartment, together with books, papers, clothes, or whatever other valuables it may contain. But still, these mischiefs, serious as indeed they sometimes are, are of small amount, it appears to me, in comparison with the benefits which termites confer on the inhabitants of tropical countries by the effectual check they continually impose on the accumulation of decayed vegetable substances.

In our climate, where the process of vegetation and of decay is comparatively slow, it is difficult properly to appreciate their agency; but in the

countries of the torrid zone, where perhaps many thousands of acres are covered by one interminable forest, and where but for such insects as the termites, the dying and the dead would continually lie in gloomy contrast with the living, the verdant characters of youth and beauty everywhere apparent sufficiently bespeak the value of their labours. In a few months, a mighty mass, inferior only to iron in hardness, and which, left to the mere action of the elements, would perhaps have encumbered the ground for a century, is mouldered into dust; and young trees, full of life and vigour, spring up in its place. Mr. Smeathman assures us that the termites will not only in a few weeks destroy and carry away the trunks of large trees, without leaving a particle behind, but that in places where there has been a populous town, if the inhabitants, as is often the case in India, have chosen to abandon it, in the course of two or three years, not even a post will be visible, but its site will be occupied by a large wood.

One peculiarity in these insects is that they usually carry on their operations by *sap* and *mine*; so that when, by eating the interior

substance, they have entirely spoiled any wooden fabric, a chair or table for example, it still externally appears untouched. They rarely attack the outside of any material, until they have concealed it and their operations by a coating of clay.

EMMA.

I am glad we have no white ants here; it must be extremely vexatious to find valuable articles so suddenly and imperceptibly destroyed.

MR. B.

I am glad too, Emma, that we have not. It would be a sad thing for us, who require ten times more timber than our climate can produce, to be subject to such marauders. There are however insects, even in our country, that are employed in performing, though much more gradually, the same services and the same mischiefs that the termites perform in India. We have several species to whom the oak beam of an ancient edifice that has weathered the storms of several hundreds of years, or a chair that has been baking in the chimney corner for half a century, or a book that has been mouldering as long on the shelf, are morsels far more delicious

than the finest living productions of the garden or the forest. You have often, I dare say, seen furniture

“By worms voracious eaten through and through :”

but perhaps you did not know that these perforations are the work of a little timber-boring beetle, (*Anobium*,) whose larvæ flourish and fatten on this dry fare. Our houses, our timber-yards, our bridges, and even our piers erected in salt water, not unfrequently suffer injury from similar destroyers.

But let us take another view of vegetable-eating insects; for we shall have but an imperfect idea of their character and importance, if we confine ourselves to an *agricultural* view of them, and enquire only how they affect our orchards and gardens, our corn-fields and forests. Besides their agricultural services, they render us others of incalculable value; services even more sensibly felt and much more readily acknowledged. You will at once perceive that I refer to the various productions for which we are indebted to them.

You are too well acquainted with the two families which man has taken under his own im-

mediate protection and management, bees and silkworms, to make it necessary to dwell on the importance of their labours; but perhaps you are not aware that there are various other little manufactures of this class to whom literature and the arts each owe a large debt of gratitude.

EMMA.

Literature! Papa.

MR. B.

Yes, Emma; *literature*. You could not be furnished either with ink to write a letter, or wax to seal it, without the aid of insects. I do not mean to say that they make either the ink or the wax; but they produce some of the ingredients most essential in the composition of these articles.

Ink is made by a decoction of blue galls with copperas and other materials. These galls are excrescences found on the leaves of a shrubby species of oak, (*Quercus infectoria*,) very common throughout Asia Minor, and are produced by a little hymenopterous insect belonging to the genus *Cynips*. The little fly punctures the surface of the leaf and deposits an egg; around which, in the course of a few hours, a fleshy chamber arises, that provides both food and shelter for

her future offspring, and becomes what is called a gall or *gall-nut*.

Thus through the intervention of a little insect, a tree, valueless in itself, yields to the merchants of Aleppo one of their chief articles of commerce. These galls are much used by dyers as well as by manufacturers of ink, and large quantities of them are every year imported. From their importance to dyers, the oak on which they are found receives its name of *Quercus infectoria* or the *Dyer's* oak.

FREDERICK.

I suppose what we call oak-apples are produced in the same manner.

MR. B.

Yes; there are many varieties of these excrescences; some resembling beautiful fruits; others curious flowers; in short, they assume a hundred different forms; but they all owe their existence to insect labourers.

MRS. B.

Some of them puzzled the old botanists not a little. The curious coronet of leaves, for instance, resembling in arrangement the petals of a rose, by which the twigs of the common willow are

sometimes surrounded, and which is formed by the deposition of the minute eggs of these little creatures, is figured by Gerard as belonging to a distinct species of tree, which he terms the *rose-willow*, and which he describes as not only making “a gallant shew, but also yielding a most cooling air in the heat of summer, being set up in houses for the decking of the same.”

MR. B.

Your mention of the *rose-willow*, my dear, reminds me of another production of the same kind, to which the naturalists of former days attributed medicinal properties of an equally wonderful character.

You must have often noticed, Emma, in your botanical researches, a tuft of little reddish moss-like fibres totally different from the leaves, growing round the twigs of the sweet-briar and the common wild-rose.

EMMA.

Yes, I have; and I have wondered what it could be.

MR. B.

This curious and beautiful excrescence is the *bedeguar*, once so famed for its styptic properties.

Its medicinal renown is, I believe, now at an end ; but all must still admire it as an elegant provision which a little insect of this order, the *Cynips rosæ*, has made, by puncturing the twig, for the shelter and maintenance of its young.

EMMA.

It appears to me that by the study of insects, I shall gain also much information on my favourite study of botany.

MR. B.

The various branches of natural history, my love, are all so intimately connected, that it is impossible to pursue any one far, without also directing attention to others. To become a geologist, for example, it is necessary to study not only mineralogy, but also anatomy, botany, and chemistry ; and to be a good botanist, you must be also, in some degree at least, an entomologist.

EMMA.

You make me feel, Papa, how very ignorant I am.

MR. B.

Well, Emma ; you know the adage, “ A sense of ignorance is the first step to knowledge ; ”—

but we are wandering from our subject;—I hope I have satisfactorily proved your obligations with regard to *ink*.

EMMA.

O yes. I am quite ready to acknowledge them—but *sealing-wax*, Papa?

MR. B.

A principal ingredient in sealing-wax is a resin called *lac*. This resin is produced by a species of coccus, (*Coccus lacca*;) the female insects having fixed themselves to a twig of the banian, the pepel, or other tree on which they feed, a pellucid and glutinous substance begins to exude from the margins of the body, and in time, the whole insect is covered with a cell of this substance, which, when hardened by exposure to the air, becomes *lac*. Under these cells the mother insects lay their eggs; which, after a certain period, are hatched, and the young ones eat their way out.

Lac is not only used in the composition of sealing-wax, but it is extensively employed in the manufacture of hats. A varnish, highly esteemed by artists, is also made from it; and when collected before the larvæ have found their way out, it yields moreover an excellent scarlet

dye. So variously useful is this insect secretion, that from one to two million pounds weight of it are annually imported into Great Britain.

Kermes is another drug valuable to the dyer. We cannot call it the *production* of an insect, for it is the insect itself. These insects, also a species of coccus, are found on a kind of oak (*Quercus coccifera*,) growing in the Levant, which, like that from which gall-nuts are gathered, is valuable only on account of its insect inhabitants.

Kermes are supposed to have furnished the material with which the curtains of the Tabernacle manufactured in the wilderness, were dyed red. From the same insects also the crimson of the Greeks and Romans was produced, and the imperishable red of the Flemish tapestries.

The *coccus cacti*, or cochineal, now supplies us with our most valuable scarlet dye. This beautiful little creature obtains its colour by feeding on the delicate red juice of a particular kind of *cactus*, or Indian fig, called in Mexico, where alone the insect is produced in any quantity, *Nopal*. So valuable is this insect, that the East India Company have offered a reward of £6000 to any one who shall introduce it into India. The

quantity of cochineal exported yearly from America is said to be worth more than half a million of money.

FREDERICK.

Really, Father, I could not have supposed that the commerce of the world could be so largely indebted to any one insect.

MR. B.

There are some to which it is under still greater obligations. The silk-worm adds many millions a year to the commercial wealth of nations; and wax and honey are far from being unimportant articles of commerce.

FREDERICK.

Does silk produce *many millions* a year?

MR. B.

Yes, many millions. Were silk no longer produced, the commerce of many parts of the world would stand still, and the people would starve. In several large provinces in the south of Europe, silk is the staple article of cultivation, and the prospect of a deficient crop causes as great an alarm as a scanty harvest of grain does among us. Many thousands of persons are employed in its first production and transportation;

and many hundreds of thousands more in its final manufacture; so that silk may be said to be one of the most important wheels that give circulation to national wealth.

EMMA.

The productions of bees have been valued from the earliest times.

MR. B.

Bees have furnished us not only with choice productions but with some of our choicest and most expressive words. A poet remarkable for the sweetness and harmony of his language, is said to be a "*bee*;" notes peculiarly soft and pleasing to the ear are said to be "*mellifluous*;" and if we would express in one word that which is pure and true, we call it, in allusion to honey drawn clear from the comb, *sincere* (*sine cerâ.*)

FREDERICK.

Honey is not much used now, is it?

MR. B.

It is not so much used in our own country as it used to be. In the good old times, housewives made from it their mead or *metheglin*, which might vie with the productions of the vine in warmer climates. In the present day,

we are so amply supplied with sugar that we can nearly dispense with it; but in many inland parts of Europe, where sugar is scarce and dear, it is still a necessary article of domestic consumption; and the care of bees is in the same proportion a lucrative branch of agriculture. Some of the peasants in the Ukraine have four or five-hundred bee-hives, and make more profit of their honey than of corn. In Spain, this luscious production is still more assiduously cultivated. A single parish priest has been known to possess five thousand hives.

Wax is a substance almost more important than honey. Our climate indeed is not so warm as to render tallow candles intolerable, as they are in some more southern countries; still, even with us, wax candles are deemed indispensable to the comfort of the great; wax is consequently, for the manufacture of candles, as well as for many other purposes, an important production to us, and large quantities are imported from different countries. Some idea of the value of wax as an article of commerce may be formed from the fact that the quantity of it exported from the island of Cuba alone, in one year, was worth more than a hundred and thirty thousand pounds.

EMMA.

Do any insects besides bees produce wax?

MR. B.

A kind called *Pe-la* is produced in China by a species of coccus, which is said, when mixed with oil, to form a wax little inferior to that made by bees; but the wax used in Europe and America is all the produce of bees, principally of the common hive-bee; though in America, a quantity by no means trifling, is obtained from various wild species.

The wax of China is in high repute among Chinese physicians for its numerous wonderful qualities; among others, for that of giving assurance to public speakers. We are told that the orators of that country eat an ounce of it, previous to commencing their harangues, to prevent *swoonings*.

FREDERICK.

An excellent idea!

MR. B.

We laugh at the nostrums of China-men, but we should remember that many in high repute in our own country a hundred years ago, were scarcely less absurd: what should we now think

of powder of silk-worm as a remedy for vertigo and convulsions; of earwigs to strengthen the nerves; of fly-water for disorders in the eyes; of lady-birds for the colic and measles; or of the cock-chaffer for the bite of a mad-dog and the plague?

EMMA.

You are not in earnest, Papa!

MR. B.

Yes, my love, I assure you, I am. Such remedies, ridiculous as they may now seem, were really in fashion in England a century ago, and empirics highly extolled their virtues.

Speaking of insects in relation to the healing art, we must not forget that there are two or three to which we are under real obligations. Among them I may mention a species of ant, which collects from the *bombyx* or silk-cotton tree, a kind of lint, said to be invaluable as a styptic; and the *Cantharides* or blister-flies; almost any article could be better spared from the *materia medica* than these flies. Their bodies contain a peculiar acrid matter which when applied to the skin, causes inflammation and raises blisters. The application, it is true, is

painful ; but it often effectually counteracts internal inflammatory action.

MRS. B.

I believe the living insect if held long in the hand, will produce the same effect as the cantharideous plaster.

MR. B.

Yes, it will ; indeed, even the vapour from these beetles has a powerful effect on the human frame. Instances have been known of persons being attacked with violent fever from having fallen asleep under trees inhabited by them. An effect similar to that of cantharides, though in a much less degree, is said to be produced by the may-bug or cock-chaffer.

EMMA.

Where are cantharides found ?

MR. B.

They are natives of almost every country of Europe, particularly those towards the south. Now and then, though very rarely, they are seen in this country. In the summer of 1837, they appeared, I am told, near Colchester, in great numbers, and stripped all the ash-trees of their leaves.

Having taken a glance at vegetable-eating insects in their various relations to agriculture, to literature and the arts, to commerce and to medicine, we will now look at a few as furnishing us with food.

EMMA.

With food, Papa !

MR. B.

Yes: several are eaten as a mere matter of taste. Many people in our country, you know, are fond of cheese-maggots, and I have heard of such a dainty dish as a maggot-pie, though I cannot say that I ever saw one. In the West Indies some epicures greatly admire the grub of the palm-weevil; and in many countries the larvæ of the larger capricorn beetles are esteemed delicacies. The *Cossus* of Pliny, which he tells us the Roman epicures fattened with flour, was probably a species of these larvæ.

Passing by these, however, I must again introduce to you the two families which I have already mentioned, as so powerful for good or evil—locusts and termites—as making some amends for the ravages of which they are occa-

sionally guilty, by the supply of food they furnish to various nations.

FREDERICK.

Were not locusts considered clean insects and permitted as food by the Jewish law?

MR. B.

Yes: and they were much eaten in Judea by those who had no flocks or herds on which to feed. It is mentioned, you know, as a proof of the simple style of life adopted by John the Baptist, that "his meat was locusts and wild honey."—Insects alone supplied his table in the wilderness.

In the present day, the nomade tribes of the desert, as well as the poor inhabitants of Arab villages, collect locusts in great quantities both for their own eating, and for sale; for these insects are highly relished by people of all classes in that part of the world. They are prepared pretty much as shrimps and lobsters are prepared with us, by being thrown alive into boiling water, mixed with a good quantity of salt. After boiling for a short time, they are taken out, the head, wings, and legs are picked off, and the trunks laid to dry in the sun.

When thoroughly dried, they are stowed away in sacks, ready either for exportation to the States of Barbary and other neighbouring countries, where in this state they find speedy sale, or for home consumption. They are frequently eaten either alone, or mixed with butter, and spread on cakes of bread; but sometimes they are stewed or fried in butter. Mr. Moffat, who has eaten them in Africa, says that on the whole they are not bad food. When well fed they are almost as good as shrimps.

MRS. B.

They appear to be a favourite article of food with most of the African nations as well as with the Arabs. I have read that the poor Hottentots, so far from regarding the arrival of a swarm as a calamity, are highly rejoiced at it, and that they soon exhibit, in their improved looks, the good effects of their improved fare.

MR. B.

Mr. Moffat tells us, that when locusts abound, the natives become quite fat, and would even reward any old lady that said she had coaxed them to alight within reach of the inhabitants. He adds, speaking of a visitation of them which

he witnessed, "We could not feel otherwise than thankful for this visitation on account of the poor; many hundreds of families, but for the locusts, must have perished with hunger."

Termites are also eaten in large quantities by some of the African nations; among the Hottentots especially they are esteemed an important article of food. After swarming, shoals of them fall into the rivers, when they are skimmed off in calabashes, and parched in iron pots over a gentle fire, in the same manner as we roast coffee. In this state they are eaten without any addition, and considered great delicacies. Mr. Smeathman, to whom we are indebted for nearly all that is known of these insects, says that he has eaten them dressed in this way, and thought them delicate, nourishing, and wholesome: sweeter than the grub of the palm-weevil, but not so fat and cloying. Their taste, he tells us, resembles sugared cream or sweet almond paste.

MRS. B.

White ants are eaten in the East Indies also, I believe.

MR. B.

Yes they are. The female ant in particular

is supposed by the Hindoos to contain highly nutritive qualities, and is eaten not only as a delicacy but as a restorative in cases of debility.

Well, I have now only to add a nice dessert and an agreeable beverage, and you will, I think, acknowledge that my bill of insect fare is complete.

EMMA.

I suppose you mean honey and mead.

MR. B.

You may add them, if you please, but I intended something nicer still.

I told you that some of the galls resemble in form certain fruits; this resemblance sometimes holds in flavour also, particularly in those that are found on some kinds of sage; they are very juicy like apples, and are highly esteemed in the Levant for their aromatic and acid flavour. Prepared with sugar, they form a considerable article of commerce from Scio to Constantinople, and will present us with a dessert of an inviting character.

And now for a beverage.—You like lemonade?

EMMA.

Lemonade! Papa.

MR. B.

Yes, Emma, *lemonade*, or perhaps I ought rather to call this insect beverage, *formicade*. If in biting a gooseberry or a plum, you have ever happened to bite an ant concealed in it, you have perceived that it had an agreeable acid taste. Ants contain this acid so abundantly, that chemists procure it from them in considerable quantities, either by distillation or infusion in water. I shall not send you, however, to the chemists, but to the ants themselves. You have only to place a piece of sugar for a few minutes in a nest of yellow ants, which may often be met with in woods, and it will absorb such a quantity of their acid, which is a perfect substitute for that of lemon, as will make you a nice glass of your favourite beverage.

FREDERICK.

The acid procured from ants is called by the chemists, *formic acid*, is it not?

MR. B.

It used to be so called; but it is now ascertained to be not a distinct kind of acid, but a mixture of the *acetic* and *malic*.

The copious secretion of acid in ants may

perhaps be accounted for from the saccharine nature of their food. They live very principally on that sweet fluid ejected by aphides, which when left to dry upon the leaves of plants, is commonly called *honey dew*. Wherever aphides abound, there you will be sure to find ants very busy, caressing the little insects to part with their luscious stores, and eagerly lapping up the excrementitious sweet the moment it is yielded.

In connection with the habitations and social economy of insects, I shall tell you something more about ants and aphides; but it is too late this evening.

FREDERICK.

You have said nothing yet, Father, about carnivorous insects.

MR. B.

I have not forgotten them; but I have now purposely confined myself to the *phytiphagi*, that I may introduce the carnivorous tribes to more advantage another time. They are equally valuable servants; but their work is of a different and less pleasing character.

NINTH EVENING.

Carnivorous insects.—Those that feed on living prey: cicindelæ, carabi, water-beetles, lady-birds; mantis, earwigs, nepidæ, notonectidæ; ant-lion, dragon-fly, lace-flies; ichneumon flies, sand-wasps, ants.—Those that feed on dead or decayed substances: larvæ of various insects; silphæ, necrophori.—Those that suck the blood of other animals: parasitic insects, fleas, gnats, and mosquitoes.—Means employed to prevent the too great increase of insects: rains, frosts, inundations; insect-catching plants; animals that consume insects; bats, birds, fishes, &c.—Calculations on the probable number of unknown species.

At our last entomological soirée, I promised you some account of carnivorous insects; a division equally numerous and useful with the phytiphagous tribes, though less generally observed and admired. If it will be agreeable to you, I shall be happy now to give an hour to the subject.

FREDERICK.

We were hoping you would indulge us this evening.

Carnivorous insects may be chiefly divided into three classes:—those that prey on living insects;

those that feed on dead and decaying animal matter; and those that suck the blood of other animals, many of which are parasitic.

The first class, those that feed on insects, are very largely distributed throughout the various orders; indeed, I do not recollect one in which some may not be pointed out as occasionally at least employing themselves in the destruction of their neighbours.

EMMA.

There are none, surely, among my little favourites the *Lepidoptera*?

MR. B.

Yes; even the *Lepidoptera*, under some circumstances will eat each other. Reaumur once put together into a glass vessel twenty caterpillars of the same species, and though he supplied them abundantly with their natural food, they nevertheless devoured one another, till only one survived.

EMMA.

What little cannibals!

MR. B.

Several others of the *phytophagi* occasionally exhibit similar cannibal propensities. Locusts, grass-hoppers, and crickets have also been known

to devour their congeners, especially when in confinement, in the most savage manner. But carnivorous insects, properly so called, are those that feed constantly and exclusively upon animal food: some, only when larvæ; others, throughout their whole existence.

Three families of the *Coleoptera*, the *Cicindelæ*, the *Carabi*, and the *Dytisci* are thus exclusively carnivorous.

FREDERICK.

To look at the *cicindelæ* with their elegant forms and splendid attire, one would not suspect them of sanguinary propensities.

MR. B.

Like some other beings they conceal beneath a gay exterior very unlovely propensities. We have six or seven varieties of them in England; the most common is the *cicindela campestris*, which, when captured, usually ejects a volatile fluid, having a powerful scent of roses. The *cicindelæ* frequent dry places exposed to the sun, run very fast, and employ their wings with more activity than most other beetles. Their larvæ form for themselves habitations in the earth, something like those of the ant-lion, which they

nearly resemble in cunning and ferocity. The name *cicindela* means a brilliant insect.

The *carabi* are a very numerous family, but, generally speaking, far less beautiful and interesting than the *cicindelæ*. Like their counterparts, tigers and lions and other carnivorous beasts, they roam by night in search of prey, and lurk during the day in any convenient retreat; generally, beneath stones or in crevices, or under loose earth or the bark of trees. They run, as I have before told you, with immense speed; and many of them, when caught, resent the affront by ejecting a dark fetid liquid that stains the skin and often produces pain and irritation.

EMMA.

Most of the specimens in the cabinet are sombre looking creatures. Their very appearance would lead one to suspect their character.

MR. B.

The majority are sufficiently uninviting; but some of them are pretty, the little sun-bugs or sun-shiners, for example; and especially the *calosomæ*; they indeed derive their name from their elegance and splendour.

The *calosomæ* differ from the generality of

the carabi in their habits as well as in their appearance. They live upon trees, both in their larva and perfect states; and by preying upon caterpillars which would otherwise denude the branches of their foliage, render us valuable services. The *calosoma inquisitor* is occasionally so numerous that a friend of mine beat down, at one time, as many as sixty specimens from the oaks in Epping Forest. The *calosoma sycophanta* is equally numerous and useful in the forests of France and Germany; it feeds upon the different insects that inhabit and injure oaks; especially upon the amusing but mischievous processionary caterpillars, living while larvæ in their nests, and like true *sycophants*, ruining the society in which they repose.

The *dytisci*, or water-beetles, are to be found both in their larva and mature states, in the tranquil waters of lakes, marshes, and ponds. They too are extremely voracious, and seize and devour without mercy all insects that come within their reach.

EMMA.

I remember you pointed out how admirably their legs are adapted for swimming.

MR. B.

If you look at the specimens in the cabinet, you will perceive that there are many varieties of size among them; some are at least an inch and a half long; others are scarcely larger than fleas. Like the carabi they shed, when handled, a most nauseous odour.

Among our insect-eating *Coleoptera*, I must not omit to mention those general little favourites, lady-birds. I told you that they always lay their eggs among aphides. Their larvæ feed entirely upon them, and thus prevent many a plant from withering under the exhaustion which these minute phlebotomists, when too numerous, occasion. If we could multiply lady-birds at will, we might perhaps entirely extirpate the *fly*, that species of aphis which so often disappoints the hopes of the hop-grower.

EMMA.

Are any of the *Orthoptera* carnivorous?

MR. B.

Some of the *cursorial Orthoptera* are. The mantis, profanely called the *praying* mantis, and said to be so benign a creature, that, "if a childe aske the way to such a place, she will stretch out one of her feet and shew him the right way, and

seldome or never misse," is an exceedingly ferocious insect. Having little muscular energy, and yet requiring a large supply of food, he makes up in stratagem and patience what he wants in power. When he has once set his eyes upon a victim, he rarely loses sight of it, but will patiently sit, even though it may be hours before it come within his reach, in an attitude prepared for seizing it.

It is the attitude thus assumed, which has obtained for this sanguinary little creature, among the ignorant, such universal veneration. In every country where it is known it has some religious epithet: the French call it *le precheur*; the Turks say it points to Mecca.

Another of the *cursorial Orthoptera*, the earwig, though it may delicately appear to prefer a juicy pear or plum, or the brilliant petals of a carnation or a dahlia, is strongly suspected of cannibal propensities: but as it flies and feeds by night, it is difficult to prove the fact. It is certain that it eats *dead* insects; there is no plunderer against whom the collector need to be more on his guard.

EMMA.

Do earwigs ever creep into the ear, and penetrate to the brain?

MR. B.

O no! Even supposing one to enter the ear, the structure of that organ, and the secretion of wax, which appears intended as a defence from all intruders, prevent the possibility of its penetrating into the head.

Among the *Hemiptera* many species of bugs live on the juices of insects. The *Nepidæ* are extremely voracious; and the little boat-flies, or water-boatmen as some call them, (*Notonectidæ*) which may often be observed lying on their backs on the surface of the water, stretched in an attitude of apparent listlessness, are not behind their larger and more powerful neighbours either in cunning or in cruelty. The moment a luckless wanderer passes within their reach, it is darted upon and quickly carried off.

I need not repeat what I have already told you respecting some of the carnivorous *Neuroptera*. The names which have been given them, such as *ant-lion* and *dragon-fly*, sufficiently bespeak their habits; to them I may add the beautiful little lace-flies, (*Hemerobii*) whose larvæ make so great a carnage among aphides that Reaumur called them “Lions des pucerons,” *Lions of the aphides*.

Two families of the *Hymenoptera*, ichneumon-flies and sand-wasps, have also been already noticed. Both, though in the mature state nectar-sipping flies, are formidable enemies of many species of insects, from the numbers they destroy as food for their young. You remember in what manner many a caterpillar is murdered by the insidious ichneumons, and with what wondrous skill and labour sand-wasps bury insects alive. When you know that in Europe alone, there are at least thirteen hundred species of ichneumon-flies, each of which attacks the larva of a different insect; and that the varieties of sand-wasps and other fossorial *Hymenoptera* that provide living prey for their young, are also very numerous, you will easily believe that these two families effectually check the increase of many of the most prolific species of vegetable-eating insects.

FREDERICK.

Are not ants carnivorous?

MR. B.

Not exclusively; though they certainly deserve a place among carnivorous insects. The mantis, fierce as it is, knows its fate, and exhibits signs of terror, when brought into contact with them. Uniting in bodies of sufficient numbers and

strength, they kill and carry off to their nests the largest and most formidable insects, and even a single ant may sometimes be seen dragging a victim many times bigger than itself. Under favourable circumstances, ants will even attack animals of larger size. They are also expert dissectors; if you wish for the skeleton of a bird, a mouse, or any other small quadruped, you have only to place the body in a box sufficiently perforated with holes to admit them, and leave it near a nest, and they will prepare it for you most skilfully.

We are told of one species of ant that is even daring enough to attack mankind. M. Malouet observed in the forests of Guiana a gigantic hillock fifteen or twenty feet high, and broad in proportion, towering in the midst of a spacious savannah, which he was informed was the dwelling of the largest species of black ant; a species so numerous and sanguinary, that any person venturing within the precincts of a society of these ants is almost sure of being devoured. If they choose to establish themselves in any neighbourhood, the colonists, it is said, are obliged to abandon it, unless they have sufficient force to form a regular siege. Nothing but fire and cannon-shot can resist them.

MRS. B.

In a country teeming as Guiana so remarkably does, with a gigantic insect population, such an enemy seems needful to lessen their numbers, and repress their depredations.

FREDERICK.

I do not envy the inhabitants either their luxuriant climate or their brilliant insects, if they must also have such compatriots.

MR. B.

My second class of carnivorous insects may be truly and properly called *scavengers*. Incessantly employed in their disgusting but necessary toils, millions of these labourers, with appetites and skill proportioned to the work they have to do, clear away the various dead bodies and other offensive substances that are daily falling to the earth ; so that, of the multitudes of insects, birds, and other animals that are continually dying, it is seldom that even one meets the eye.

Among these, some species of larva hold, as you already know, a conspicuous place ; but there are some perfect insects, to which we are under equal, and perhaps even greater, obligations. I refer to various beetles of the *Silpha*

genus, whose olfactory powers are so keen, that like vultures they scent from afar the carrion upon which they feed, and will come soaring along, sweeping with the velocity of a bee around the cadaverous substance which has attracted them. The offensive appearance of the *Silphæ*, properly so called, and the fetid odour they exhale, sufficiently indicate their manner of living, and their habitation. Both they and their larvæ are chiefly to be found in dunghills, and in putrescent animal matter, and they offer nothing beyond the fact of their services to engage our attention. But one family of this genus, the *necrophori*, are extremely interesting. They receive their name from their peculiar habit of burying the carcasses they find to serve as food for their young. No sooner is the decaying state of any small animal perceptible, than they flock to the place, and so skilfully hollow out the earth underneath the body, that in the course of a few hours, it is entirely buried.

Mr. Kirby gives a most interesting account from an eye-witness, of the habits of one species of these insects, (*Necrophorus vespillo*.) Four of these little creatures were put into a glass vessel half-filled with earth, and properly secured.

Upon the surface of the earth two frogs were laid. In less than twelve hours one of the frogs was interred by two of the beetles ; the other two ran about the whole day, as if measuring the dimensions of the remaining corpse, which on the third day was also found buried. A dead linnet was then introduced, upon which a pair of beetles were soon engaged. They began their operations by pushing out the earth from under the body, so as to form a cavity for its reception ; occasionally dragging at the feathers from below to pull it into its grave. The bird was lifted up, turned, trodden upon, and pulled down, till the next morning it was an inch and a half under the ground ; in the evening, it had sunk half an inch lower ; and in another day, the work was completed, and the bird covered. Other small animals continued to be added, which were all, sooner or later, buried ; and the result of the experiment was, that in fifty days these four beetles had interred in the very small space allotted to them, twelve carcasses :—four frogs, three small birds, two fishes, one mole, and two grasshoppers, besides the entrails of a fish, and part of the lungs of an ox. In another experiment, a single beetle

buried a mole forty times its own weight and bulk in two days.

EMMA.

I suppose they do not bury them deep.

MR. B.

Generally at the depth of ten or twelve inches. Having excavated the soil till the body has sunk to about that depth, they cover it over with the removed earth.

What is still more remarkable, if the spot on which the carcase happens to be found is not suitable to the purpose of interment, four or five of them appear to consult together, and getting beneath the body, are seen to convey it slowly to some other that is better adapted.

EMMA.

What astonishing instinct! I do not wonder, Papa, at your speaking so highly of the sagacity of insects.

MR. B.

It is not merely by interring dead animals that these diligent little creatures render us service. Some species inter also manure, and that in such considerable quantities, as in some parts greatly to enrich and fertilize the earth. In the interest-

ing narrative published by the "Scottish Mission of Enquiry respecting the Jews," Dr. Keith and his companions state that they remarked in the desert between Egypt and Palestine numerous green patches on the sand, which they found to be produced by the industry of these small but indefatigable operators. "The beetle," they add, "with amazing labour drags the camel's dung into its hole in the sand, and thus a fruitful soil is formed ready to receive the seed of plants. To this small insect we probably owe the greater part of the verdure of the wilderness."

Thus while phytiphagous insects dig and prune, these beetles manure the soil of many a desert region.

We will now turn to the third class of carnivorous insects, those that suck the blood of other animals. They are so universally voted a nuisance, that I can scarcely expect you to be of a different opinion.

MRS. B.

Many apparent nuisances are indirectly of great utility.

MR. B.

True, my dear: and an impartial view even

of these insects will prove the correctness of your remark. Some of them are *negatively* useful; lice and fleas, for example, by enforcing the necessity of attention to cleanliness; their timely bites so continually remind animals of putting their fur or feathers in order, as to prevent the diseases which negligence would probably occasion; and others of them, there is no doubt, render positive services by the continual application of their lancets to vigorous animals, thus averting the mischiefs which might arise from plethora, or too great fulness of blood.

FREDERICK.

But man does not require such services from them.

MR. B.

Perhaps not: and man may, if he please, be free from their intrusion. It is his own fault if he is seriously affected by any of them.

FREDERICK.

Can he free himself from the torment of gnats and mosquitoes? Our old poet Spencer says:—

“ Their murmuring small trumpets sounden wide,
Whiles in the air their clustering army flies;
Ne man nor beast may rest or take repose
From their sharp wounds and noyous injuries.”

MR. B.

I am glad you have quoted Spencer ; because, by comparing his description with our present almost entire freedom from these torturing animals, you will be more readily convinced that the degree of annoyance endured from them in any country greatly depends on the degree in which the drainage and cultivation of the land is neglected. The passage, I recollect, begins,

“As when a swarm of gnats at even-tide
Out of the *fennes* of Allan doth arise.”

Wherever there are *fens*, that is to say, large tracts of marshy land and stagnant pools, there these insects, whose little egg-boats are launched, and whose larvæ live in feculent water, are necessarily abundant ; but in well-tilled lands, like the greater part of our own in the present day, where there are few waters but running brooks and limpid springs, their “murmuring small trumpets” and “clustering armies” are seldom heard or feared. You remember that Dr. Clarke, who was so seriously annoyed by them in travelling along the frontier of Circassia, states that “the carriage had just been dragged, for many miles together, through *stagnant pools*.”

EMMA.

Poor Dr. Clarke! I remember greatly pitying him, when I read that part of his Travels;—not daring to open a window in his carriage on the most sultry night he ever felt, for fear of the swarms that would force their way in; and notwithstanding all his precautions, having his ears and nostrils filled with them, and his lamp extinguished the moment it was lighted, by the prodigious numbers that heaped themselves in a cone over the burner.

MR. B.

Little idea can be formed of the torture which these insects occasion to the inhabitants of all badly-cultivated lands, from the icy regions of the frigid zone to the sultry climates of the equator; but travellers give us such accounts of it as may well make us thankful for our general freedom from them.

We have now taken a glance at the insect world in its relation to other parts of nature and to ourselves. In connection with it, I have often thought with gratitude of the various means that the same merciful Providence, which has appointed us these tiny servants in such countless multitudes

and directed their labours to purposes so beneficial, has employed to restrain them within due bounds. Prolific as they are, they rarely increase beyond the extent in which their services are actually required.

EMMA.

Do not gnats?

MR. B.

No, not even gnats. They are numerous only in proportion to the stagnant waters that they are required to purify.

The disposition, so extensively prevalent among insects, to destroy each other, is not the least of these means; but besides enemies so abundantly found among creatures of their own class, it seems as if all nature, animate and inanimate, had it in charge to prevent their too great multiplication.

Among their inanimate enemies, I may mention continued rain, which greatly diminishes the number of caterpillars, and often leaves us nearly free from some species for a series of years. Late frosts, which destroy great multitudes in their larva state; and inundations, by which many that undergo their transformations in the earth are drowned.

Various insect-catching plants also destroy vast numbers. Mr. Kirby says that it is scarcely possible to find a flower of the *muscipæ asclepiadæ* that has not entrapped its victim; and in the United States, these flowers sometimes closely cover hundreds of acres together.

The *muscipæ*, or fly-catching plants, may be divided into three classes:—those that entrap insects by the irritability of their stamina, which when touched, close upon them; those that ensnare them by some viscous secretion; and those that entice them by their carrion-like odour. Some of these contain water, in which the unwary trespassers are drowned; and others poison the eggs which by mistake are intrusted to them.

But the most formidable enemies to insects are found in the various departments of the animal kingdom. In each class, from the feeble, half-vegetating polype to the beasts of prey that roam over the desert, we meet with creatures whose chief office seems to be the destruction of insects.

Among the *Mammalia*, bats hold in this respect a conspicuous place. They fly in the twilight, just at the time when many moths leave their hiding-places and hover round the flowers, and

multitudes of these nocturnal invaders fall victims to them. They also consume many of the night-flying beetles, particularly of the weevils which attack, sometimes in a merciless manner, the buds and flowers of fruit-trees.

FREDERICK.

I dare say then it is owing to bats that the trees in the Castle grounds are so remarkably free from insects. The gardener was saying the other day he could not account for it.

MR. B.

I have no doubt that it is. Orchards planted near barns, churches, or any buildings that afford shelter to bats, are much less liable to insects than those in more open situations.

Among the insectivorous *Mammalia* are also various sorts of mice, with moles, badgers, hedgehogs, squirrels, pigs and foxes. Some of these creatures are, it is true, themselves mischievous to the productions of the garden and the farm ; but others, and especially the squirrel and the hedgehog, deserve our unqualified gratitude.

Birds contribute still more than mammiferous animals to the destruction of insects, particularly during the breeding season. I have already

told you what a number of caterpillars a pair of sparrows having young ones to maintain, have been computed to destroy in a week. All the *Passeres*, that is, birds of the sparrow kind, which constitute at least one half of the whole feathered creation, devour insects voraciously. When the migratory species begin to take their leave of us in the autumn, we are soon made sensible of their absence by the much greater annoyance we experience from flies and other *Diptera* on which they more especially feed.

The *Scansores* or climbers too, such as woodpeckers, wrynecks, cuckoos, and many others, are equally devoted to the destruction of insects; they attack the larvæ of many large species that harbour in the trunks or among the boughs of trees, some of which the smaller birds would be unable to destroy. The cuckoo consumes various hairy caterpillars which few other birds will touch.

MRS. B.

I believe all birds that feed on grain or fruit, feed also more or less, on insects.

MR. B.

Yes: indeed I do not know any to which they are wholly unacceptable. Owls devour a great

many of the night-flying beetles, and locusts are pursued not only by that species of thrush called the locust-bird, but by vultures, kites, and hawks which generally follow in their train, and consume great numbers.

When to these enemies we add fishes, serpents, frogs, toads, and various other reptiles, particularly lizards, all of which feed largely on insects, we shall admire the wise economy that has placed an effectual barrier to the too great increase of these little creatures by making them, when they have fulfilled their allotted tasks, subservient to the sustenance of so many animals.

FREDERICK.

Really, with such multitudes of enemies, one would imagine the insect races must soon be wholly extirpated.

MR. B.

Remember how immensely numerous they are. The twenty thousand or perhaps more than twenty thousand species to be found described in books and arranged in cabinets, probably bear but a very small proportion to the whole existing number. There are ten thousand species, or more than six to each plant, in our own country; adopting this

average as a standard, it has been calculated that as there are fifty thousand known species of vegetables in the world, there may be, taking the varieties of parasitic insects into account, three hundred and fifty thousand or perhaps four hundred thousand of insects. And not only are the species immensely numerous, but the individuals composing many of them are multitudinous beyond all calculation. Look, for example, at locusts, whose armies are so vast that, as it has been remarked, all human attempts to diminish their numbers would appear like attempting to drain the ocean by a pump;—at the ephemeræ that emerge at certain seasons of the year from the rivers of France, by myriads of millions;—at most of the numerous species of lepidopterous insects, some of which have been observed to fly in clouds, and to descend like snow storms;—or at the varieties of flies, gnats, midges &c., which fill the air in every place and at almost every season, with their dancing myriads.

But our hour is expired, and an engagement obliges me now to leave you.

EMMA.

I hope, Papa, you will find at least one more

leisure hour before I return to school. I have heard nothing yet about either the architects or the paper-makers.

MR. B.

I intend, if possible, to introduce them to you to-morrow evening.

TENTH EVENING.

Habitations of insects:—Structures of hive-bees; of humble bees; of carpenter-bees; of mason-bees; upholsterer-bees—story connected with their nests.—Character of wasps;—their structures; nests of hornets; of paper-wasps of Cayenne:—Ant hills; peculiarity in hillocks of yellow ants.—Domestic economy of bees, wasps, and ants:—care of their young;—slave-dealing ants: pastoral ants.—Peculiarities in the instinct of bees:—honey; wax; bee-bread; propolis, employed to fortify and defend their combs;—sentinel-bees; robber-bees.—Means of defence of insects:—stings; secretions;—bombardier-beetles;—disguises;—noises;—death-watch: musical cicada;—grasshoppers.—Luminous insects:—scolopendra electrica; glow-worm; fire-flies; lantern-flies.—Various superstitions connected with insects:—ignes fatui; showers of blood.—Conclusion.

The last evening! said Emma, as she entered the study and cast a disconsolate look at the cabinet. I do not mean that I shall be sorry to return to school; but I really do very much regret that our pleasant evenings are now at an end.

MR. B.

I regret it too, my love. However, I hope that at no very distant period we shall have the pleasure of your society permanently; and that we shall then have many opportunities of pursuing together various branches of natural science, and unitedly admiring the minute as well as the vast works of God.

We are this evening to peep at the various habitations which some of our insect artisans construct. In speaking of insects in their larva state, I mentioned a few structures formed during that period of their existence. You remember the silken tents of the lackey and other caterpillars, and the den of the ant-lion. Several other fabrics formed during this infant state might have been added: the little patchwork coat, for instance, which the grub of the clothes moth (*Tinea sarcitella*) manufactures for itself; and the still more remarkable shelters which the various species of *caddis* or case-worms (*Phryganæ*) form, balanced with such nice regard to specific gravity.—

FREDERICK.

They are indeed curious. I have often looked

at them with wonder when I have picked them out of the brook to bait my fishing rod.

MR. B.

Had we time to examine them, they would well repay us for our trouble; but we must now confine ourselves to perfect insects.

Among perfect insects, the builders chiefly deserving of our attention, with the exception of *Termites*, are bees, wasps, hornets and ants. They all belong to the *Hymenoptera*, and have been properly denominated, from their superior instincts, *principes* or chiefs of the insect world.

Let us look for a few minutes at the varied architecture of bees; and first we will pay a visit to the hive bees.

The interior of a bee hive is one of the most wonderful things in nature. The most profound philosopher, equally with the most incurious observer, is struck with astonishment on inspecting it. It is indeed a city in miniature, containing storehouses, habitations for the citizens, and palaces for the sovereign; all constructed of materials, and formed on a plan, which the most expert artist would endeavour in vain to imitate. In all ages, philosophers have devoted their lives

to an examination of it, and still its construction remains a miracle. As our time will not allow me to attempt a description of it, I must content myself with remarking that the cells of which it is composed are built on such exact geometrical principles, that if the question had been proposed to the most skilful geometrician, how, at the smallest expense of space and material, to form cells of the greatest capacity and strength, he could not have devised a better plan than that which bees have adopted. They do not make them cylindrical, for that shape would have left numberless vacuities; nor square or triangular, for then a greater quantity of wax would have been required, and besides that shape would not have been adapted to the form of their bodies; but hexagonal; by which form, as well as by other peculiarities in their structure, they are rendered convenient to the inhabitants at the least possible expense both of material and of room; and at the same time, are much stronger than they could have been by any other arrangement.

FREDERICK.

Humble-bees construct honey-combs too; do they not?

MR. B.

Yes: but their structures will scarcely better bear comparison with those of the hive-bee than the huts of savages will with the houses in Regent's Park. They usually make their nests underground.

There are several solitary bees that form for their young very curious habitations. Some have been termed *carpenter bees*, particularly the *apis violacea*, found in the south of Europe, which bores tunnels in a beam, or some other old and dry wooden substance, from twelve to fourteen inches long, and large enough to admit my finger. These tunnels she divides with a kind of mortar made of the saw-dust, into ten or twelve compartments, lodging in each, before she leaves it, an egg, and a quantity of bee-bread.

Another, the *apis muraria*, which deserves to be called the *mason-bee*, forms a castle of sand, consisting of eight or ten cells, in each of which is deposited an egg with its supply of food. These castles may be frequently seen on garden walls exposed to the sun: to a careless observer they appear like lumps of mortar stuck against the wall; but if an attempt be made to remove them, they will be found to resist the impression of the strongest knife.

A third tribe, appropriately called *upholsterers*, excavate holes in the earth, or sometimes in decayed trees; and having lined them with an elegant coating of flowers or of leaves, deposit in them an egg and the necessary quantity of bee-bread. One species, the poppy-bee, lines hers with the scarlet petals of the wild poppy. Another, called the leaf-cutter-bee, having formed a hole eight or ten inches long, fills it with cells formed of pieces of rose-leaf, so variously convoluted, and the cells fitted one into another with such nice precision, that if we did not know who guides even the insect to discretion, we should never credit their being the work of such an artificer. Each cell, when finished, is nearly filled with a rose-coloured conserve, composed of honey and pollen; an egg is laid in it, and the orifice is then closed with three pieces of leaf so exactly circular, that a pair of compasses could not define their margin with more exactness.

Reaumur tells an amusing tale in connection with these nests. A gardener at Rouen having dug up some of them, was exceedingly terrified at the appearance of such curious structures. Considering them to be undoubtedly produced

by witchcraft, and to forebode some dreadful calamity, he took them to the parish priest, who, equally ignorant and superstitious, confirmed his apprehensions, and advised him to lose no time in proceeding to Paris, and showing them to his master. The man, however, who was not deficient in good sense, thought he would first take the opinion of Nollet, an eminent naturalist in the neighbourhood. Nollet easily explained the mysterious appearance; and by pointing out the grub, soon dispelled the man's fears, and spared him the expense and trouble of a long journey.

And now, Emma, for the *paper-makers*.

FREDERICK.

They are the wasps and hornets.

MR. B.

Yes : races which are to the peaceful industrious bees, what lawless banditti lurking in forests are to the honest inhabitants of towns and villages. They live wholly by rapine; and many a bee, as she returns laden with treasure to the hive, is waylaid and murdered by these ruthless plunderers.

MRS. B.

Blue-bottle flies often share the same fate.

MR. B.

On that account, butchers consider wasps and hornets their friends. These fierce marauders pounce upon their victim, whether bee or fly, and tumbling it to the ground, and separating in a trice the soft juicy body from the trunk, hurry off with it to their nest, where the delicious morsel is soon devoured by themselves and their companions.

But as it is with their buildings rather than with their character that we have just now to do, I shall not at present dwell longer on their violent proceedings, but shall introduce you to their habitations, which present them in a far more pleasing light.

“The wasp, fine architect, surrounds his domes
With paper foliage, and suspends his combs.”

I have here a nest of the common species, which you may examine for yourself. Its exterior figure, you observe, is not unlike a large India-rubber bottle, only that the outside surface is neither smooth nor uniform in colour. Its want of uniformity is owing to the various materials of which the paper is made.

EMMA.

It has two apertures, I perceive; one, I suppose,

for ingress, and the other for egress.—How large it is!

MR. B.

It is more than a foot in diameter; I will divide it in the centre, and show you its internal construction.

The envelope or outer covering, which is nearly an inch in thickness, is not solid, but is formed of separate layers of paper with intervals between them, so as to render it impervious to moisture. The interior contains fifteen or sixteen combs of a diameter proportioned to that of the envelope, and formed of the same material, all arranged in stories. These cells are not like those of bees, intended partly for store-houses, but serve merely as habitations for themselves and their young.

EMMA.

Really, the material looks very much like paper; where do they get it?

MR. B.

They make it of the fibres of wood which they detach with their powerful jaws from any timber that suits their purpose; when they have amassed a heap of the filaments, they moisten the whole with a few drops of a viscid glue from their

mouth, and kneading it with their jaws into a sort of paste, or *papier mâché*, roll it up into a pellet, and fly off with it to the building they have in hand. On arriving, they attach it to that part at which they were at work, spreading it into thin laminæ by means of their jaws, tongue, and legs. Most vespiaries are formed underground, and out of sight, generally at a depth of about six inches from the surface; but I once placed one which had been dug up in the garden, under a glass hive, when the wasps very obligingly went on with the process, and gave me an opportunity of observing it.

The nest of the hornet, (*Vespa Crabro*,) the fiercest of the *Vespa* tribe, resembles in its general construction that of the common wasp, except that it is of a much rougher texture; and is built, not in the ground, but either in the holes of old walls, or the trunks of decayed trees.

MRS. B.

Curious as are the vespiaries in our own country, we have none so elegant and exquisitely fine as that of the *polistes nidulans*, or paper-wasp of Cayenne. I once saw one. It was constructed of a substance like beautifully-polished white paste-

board, so solid as to be impervious to the weather. In shape it resembled a bell. It was eighteen inches long, and had been suspended by its upper end to the branch of a tree. The interior was fitted up with numerous combs for the convenient accommodation of its inhabitants.

MR. B.

We have wasps in our own country that form nests nearly of the same shape, only very much smaller. Here is one which I once found suspended to the eaves of the summer-house. It is scarcely more than an inch in length; and is formed, not of polished white card-board, but of thin, whitish brown paper.

EMMA.

How beautiful the large white ones must appear suspended among green leaves!

FREDERICK.

Ants too are skilful architects, are they not?

MR. B.

Many of them erect gigantic edifices, formed of various materials, and internally composed of numerous apartments of different elevations; but as *mechanics*, ants are not equal in exactness and skill to bees and wasps. Some species build with

earth, blades of grass, chaff, grains of corn, or any other substance they may find at hand, availing themselves of showers of rain to furnish water,—the only cement they possess. Others, the yellow ants, for example, frequently establish themselves in trees, where they select for building materials the finest parcels of rotten wood, mixed with earth and the webs of spiders.

The mention of yellow ants reminds me of one peculiarity in their erections which I believe does not belong to the elevations of any other species; and among them is chiefly confined to those that build upon mountains; their hillocks have an elongated, regular form, and are constantly directed from east to west; so that they serve as a sort of compass to the inhabitants of the Alps, when they have wandered out of the way during the night, or are environed by thick fogs or mists. M. Huber says, that he has verified by observations on thousands of them the facts which were communicated to him by the mountaineers.

In connection with the edifices of ants, we must not forget those of the termites. The termites belong, as you know, to a different order of insects, but are not outdone in architectural skill by any of the hymenopterous *principes*.

These little creatures, scarcely the fourth of an inch in length, erect edifices sometimes twelve feet high, and of a proportionable bulk, adorned without by numerous pinnacles and turrets, and sheltering under an ample dome myriads of vaulted apartments of various dimensions, constructed of different materials, and designed for different purposes:—one in the centre for the mansion of the king and queen, who are there immured for life; others around for their numerous attendants; some for nurseries; and others for magazines, in which stores of food consisting of gums, inspissated juices of plants, and particles of wood, are laid up. They form, moreover, in different directions and at different depths, innumerable subterraneous roads or tunnels, some twelve or thirteen inches in diameter, with arches and bridges connecting one part with another, not excavated, but actually *projected* with all the skill of an engineer. I speak now more particularly of the erections of the *termes fatalis*, a species very common on the coast of Africa. When a cluster of them, as is often the case, are placed together, they might be taken for an African kraal; they are, in fact, sometimes larger than the huts which the natives inhabit.

The domestic economy of all these insects is as remarkable as their talent for architecture. Not only bees, but wasps and ants watch over their young, keep them in a state of extreme cleanliness, and feed them with the utmost assiduity. Bees supply their grubs with a whitish-coloured jelly, prepared on purpose for them, and when they cease to eat, carefully cover them up in their cells with a waxen lid, and leave them to undergo their transformation into pupæ. When that is accomplished, and the young bees awake to new life and issue from the cells in which they had reposed, the anxious nurses flock around them, lick them clean, supply them with food, and having thus finished their preparation for labour, and seen them sally forth on their first day's toil, begin to clean out the cradles in which they have lain, and to fit them for the reception of a fresh set of tenants.

Wasps and ants feed their larvæ from the mouth, nearly in the same manner as birds feed their young, giving them, from time to time, a small quantity of aliment which has been prepared and rendered sufficiently digestible in their own stomachs.

But the history of the *principes* is so full of wonders that I scarcely know what to select. M. Huber seems to have thought them, and especially ants, endowed with all but human intellect. He gives us such a lively account of the slave-dealers among these little creatures, of their flocks and herds, of their gymnastics and wars, and of their actions of kindness towards their friends, that we are tempted to ask, can this be true of creatures so diminutive and apparently so insignificant? The facts he states have, however, been so repeatedly verified by subsequent and close observers, that, however much we may wonder, no room is left for us to disbelieve or doubt.

FREDERICK.

What are the slave-dealers, Father?

MR. B.

The Amazon, or legionary ants, (*formica rufescens*;) they are not found in our country, but were observed by M. Huber in the neighbourhood of Geneva, where they are not uncommon. These ants are both warlike and powerful, but unlike the rest of the tribe, far from industrious. To relieve themselves therefore from the necessity

of labour, they attack the dwellings of the ash-coloured ants, or *negroes*, as they may be called, and carrying off the larvæ and pupæ of this industrious, peaceable, and stingless race, devolve upon them the whole care of procuring provisions, of nursing and educating their young, and of building and defending their habitations. It is pleasing to add that these poor little slaves, though “forced from home,” transported to a foreign soil, and obliged to labour for strangers, experience no oppression, but are treated by their kidnappers with such kindness that soon all seem to form but one family, and to have but one interest.

After what I have already said of the fondness of ants for aphides, you will perhaps guess in what their flocks and herds consist. It is a well-attested fact, that some species carry their taste for these little melliferous insects so far as to be at the trouble of transporting them into the interior of their habitations, where they watch over them with as much care as we employ towards our cows and sheep. The yellow ants, to which I recommend you to apply for lemonade, are remarkable for the instinct they display in

this particular. These ants are different in their habits from most others; they scarcely ever issue from their subterraneous abodes, and are not to be met with on the leaves or fruits of trees. How then can they subsist? As M. Huber pleasantly remarks, "they are a pastoral people, and derive their subsistence chiefly from their flocks and herds of aphides; these," he adds, "are their cattle, cows, or goats; and an ant-hill may be considered more or less rich according to the number of aphides which it possesses."

The preservation of aphides is an object of so much interest to these ants, that even their eggs receive from them the greatest attention. They lick them continually, invest them with a gluten which cements them together, and in a word, perform for them all that is necessary for their preservation and fecundity. Ants are excellent herdsmen.

There are four or five species that thus possess aphides; but in a smaller number, and less constantly, than the yellow ants. Those that climb trees loaded with these insects, and there enjoy their sweets, are less careful to cultivate them at home.

EMMA.

Really, Papa, ants are wonderful little creatures.

MR. B.

You would indeed think so, did time allow to tell all that is to be told respecting them.

FREDERICK.

I cannot think that ants are more wonderful in their instincts and habits than bees:—look at the order they observe in swarming; at their attachment to their queen; at the ventilation of their hives, and the various means they employ to defend them; at the economy with which they lay up whatever of honey and bee-bread they collect, more than they require for immediate use: and especially at the unaccountable fact, that however far they may be from home, when they return, they fly in a direct line to their nest without ever missing the way.

MR. B.

I am not disposed to give to ants the precedence of bees, I assure you. Another remarkable display of the intellect of bees is exhibited in collecting the farina of which they make their *bread*. On whatever flower the bee first alights to gather it, she continues gathering from that kind of

flower alone during the whole excursion, even though it may be much scarcer than many others. If she begin with a violet, for example, she will continue to collect from violets only, till having filled with pellets of the ambrosial fare the little baskets with which her legs are furnished, she returns laden with them to the hive.

EMMA.

I do not yet quite understand the difference between bee-bread and honey.

MR. B.

Honey is a sweet fluid which the bee sucks up with her tongue from the nectarium of flowers, and also from the sweet juices of fruits. Having stored it in the first stomach, or honey-bag, on returning home, she either pours it into one of the cells prepared for it, or gives it to such of her companions as have been at work within. From the nectar that furnishes honey is elaborated also the wax of which the cells are formed.

Bee-bread is made of the pollen of flowers. When the bee has filled her honey-bag, she next, before returning home, collects, as I have described, the farina for *bread*, the chief food both of old and young. On arriving at the hive, having

eaten herself, and given to her friends engaged in domestic toils, as much of it as they require, she carefully stores up what remains in some of the empty cells for future use. In some combs, a large proportion of the cells are filled with this bread; an adequate supply of it being indispensable for bees during the winter season. If robbed of their honey, treacle will do in its place; but no substitute has yet been found for this more solid and equally important viand. When deprived of it, they become consumptive and die.

Besides honey and pollen, bees collect another substance called *propolis*. This is a resinous gum, gathered from poplars and other trees, and is employed to line and strengthen the angles of the cells, and to stop up every crevice by which cold, wet, or any enemy might enter.

FREDERICK.

Is it not with this substance mixed with wax that bees sometimes barricade their hives to prevent the entrance of the death's-head moth?

MR. B.

Yes: and with it they embalm any intruder that they cannot otherwise get rid of. If a slug

or snail, for instance, have the audacity to enter and walk over the comb, they first quickly sting him to death, and then, having no means of removing so large a body, and fearing the noxious effluvia arising from corruption, cover it over with propolis.

EMMA.

What astonishing instinct!

MR. B.

This is not the only proof they give of instinct in defending their hives; on the principle that prevention is better than cure, they place sentinels at the entrance to ward off moths and other creatures, that might otherwise intrude during the night. On a fine moonlight evening, you may often see the bees on guard, parading backwards and forwards before the opening of the hive; if they happen to detect an invader, he falls an immediate victim to their just vengeance.

Not unfrequently they have to defend themselves also against their own species. It is no uncommon thing in an unfavorable season, when flowers are scarce and provisions consequently difficult to be obtained, for some bees to get into bad habits and endeavour to rob their neighbours.

A robber-bee may at once be known by his shining, darker colour, caused by having lost his hair in combats ; and also by his sneaking manner of approach ; he does not fly boldly into the hive, but generally tries to enter at some unfrequented crevice at the back. If robber-bees effect their entrance, fierce battles ensue, in which assailants and defendants poignard each other with their stings in a merciless manner, and many are slain. Sometimes the robber-bees prevail, and get possession of the coveted stores ; but if the attacked hive have a good, courageous queen, they usually fight bravely and defeat the invaders.

FREDERICK.

Bees have no weapon besides their sting, have they ?

MR. B.

No : but that is a fearful instrument of slaughter : a bee cannot be killed so suddenly, except by crushing, as by the sting of another bee. Watching an opportunity, the enemy darts its sharp point between the scales of the body, and the next instant, the defeated bee stretches out its quivering wings and expires.

Mrs. B.

Ants, I believe, defend themselves chiefly by their acid.

Mr. B.

Those especially that have no sting. Having bitten their victim, they insinuate into the wound a small quantity of this secretion which dispatches it instantly. In this manner they often kill large insects which they are unable to capture alive. The acid effluvia proceeding from the myriads in an ant-hill are said to be sufficiently powerful to kill a frog.

Many insects, besides ants, employ noxious secretions as a means of defence. One species of carabus, occasionally found here, (*Brachini*,) the *Bombardiers*, as they are called, employ that with which they are furnished in an amusing manner. When a *Brachinus crepitans* is pursued by its great enemy, *Calosoma inquisitor*, it seems at first to have no means of escape, and you fancy it is about to submit to its persecutor: suddenly, however, a loud explosion is heard, and a blue smoke attended by a very disagreeable scent is seen to issue from the insect, and effectually to stop the progress of the assailant. The *bombardier* can fire his artillery twenty times in

succession, if necessary, and by this means gain time to effect his escape.

If we had leisure to enter more at large on the modes of defence employed by insects, I could name others that would perhaps equally amuse you. Several defend themselves from those enemies that will feed only on living prey, by simulating death: many a dung-chafer thus avoids the hungry bill of the rook. Others secure themselves by assuming various disguises: some caterpillars fix themselves by their hind-legs to a branch in such a position that they look exactly like a little twig of it, and thus elude the pursuit of birds; wood-lice roll themselves up into a ball; one species, when thus rolled up, so exactly resemble beads, that Swammerdam's maid-servant, finding a number of them in a corner of her master's garden, actually set about stringing them for a necklace: but they did not carry on the deception quite long enough; and beginning to move and to struggle for liberty, the poor girl quickly threw down her prize, and ran away screaming in the utmost terror.

Noises are another means of defence to which insects have occasional recourse. The death's head moth, when menaced by the stings of myriads of

enraged bees, whose property she is plundering, knows how effectually to disarm them of their fury by uttering her shrill, plaintive note. Many beetles, as the dung-chafer, carrion-chafer, burying beetle and others, when taken, show their alarm by a shrill sibilant or creaking sound, produced by rubbing the ends of their elytræ with the extremity of the abdomen; and bees, wasps, and hornets, as is well known, emit various tones, as they are influenced by the emotions of fear, of anger, or of gladness.

The number of insects that have the power of producing sound is however small: very many in every order are perfectly silent. None of the *Neuroptera* are vocal; nor of the *Lepidoptera*, with the exception of the death's-head moth.

FREDERICK.

You mentioned some of the *Hemiptera* as musical.

MR. B.

The most vociferous insects belong to that order. Some of the *Orthoptera* are however sufficiently noisy. With the vocalists of both, love is the soul of song; animated by its inspiring principle, the males of some species of the grasshopper

and cicada tribes have even rivalled the performances of man.

EMMA.

Are not the females musicians too?

MR. B.

No: they are too diligent so to amuse themselves. The saucy Xenarchus says,—

“Happy the cicada’s lives,
Since they all have voiceless wives.”

The notes of insects and their instruments for producing them, from the gentle tap of the concealed little death-watch, whose sound is full of alarm to the superstitious, to the loud chorus of the melodious harpers, whose tune charmed even Athenian ears, are very various.

The death-watch (*Anobium tessellatum*,) so called because the sound it emits resembles the ticking of a watch, produces its terror-inspiring call by raising itself upon its hind-legs, and beating its head with great agility and force against the plane of position. The sound is exactly like that produced by the tapping with the fingernail upon the table; and when familiarized, the insect will answer very readily to the tap of the nail, supposing it to be a response from his companions.

FREDERICK.

I think I can guess what insects you mean by the “melodious harpers;” for I recollect to have read that a cicada sitting upon a harp was the usual emblem of the science of music among the Greeks.

MR. B.

You recollect then the story of the two rival musicians, Eunomus and Ariston, who were engaged in a contest of skill, when a cicada or *tettix*, settling upon the harp of the former, supplied the place of a broken string, and secured to him the victory. To excel this insect seems to have been the highest commendation of a singer; and even the eloquence of Plato was not thought to suffer by a comparison with it. The instrument of the cicada for producing sound is a species of drum, of very complicated structure.

EMMA.

I suppose we have none of these musical insects.

MR. B.

No: they are inhabitants of much warmer latitudes. With the Athenians they were such favourites, that they were kept in cages for the sake of their song, and golden images of them were worn as ornaments.

Mrs. B.

The ladies in Spain keep grasshoppers in cages at the present day for the pleasure of hearing their chirp.

Mr. B.

Many persons in different countries have evinced a similar taste. The learned Scaliger so admired the note of the house-cricket, that he always kept some in a box in his study.

EMMA.

Is there any difference between the note of the cricket and the grasshopper?

Mr. B.

The song of the grasshopper is a short chirp, regularly interrupted; that of the cricket is long and continued. You may frequently hear both the field-cricket and the grasshopper in rural districts, where their cheerful notes lend additional charms to the glowing beauties of a summer's day.

There are insects of another kind that add charms to the brilliancy of summer, which I must not omit to introduce to you. I refer to such as are luminous. A small species of millepede (*Scolopenda electrica*,) when the sun has shone on it during the day, may often be seen shining in the evening upon our garden-paths with a

pale softened light; but our most brilliant insects are glow-worms, the females of a species of beetle, (*Lampyrus*.)

EMMA.

The three Frederick put into a glass phial and brought home in the carriage the other evening, gave sufficient light to enable me to see the hour by my watch.

MR. B.

Our glow-worms are but cottage rush-lights compared with the lamps that glitter in tropical countries. The light emitted by the fire-fly (*Lampyrus noctilucus**) of the West Indies, is so brilliant that the smallest print may be read by moving one of them along the lines. In St. Domingo, we are told, the natives used to employ these living lamps, which they called *cucuij*, in the place of candles; and when they travelled, secured sufficient light by tying one to each great toe.

Southey has beautifully described the first effect of their brilliancy on the British visitors of the New World:—

“Sorrowing we behold
The night come on; but soon did night display
More wonders than it veil'd; innumerable tribes
From the wood cover swarm'd, and darkness made

* Plate III. Fig. 5.

Their beauties visible : one while they stream'd
 A bright blue radiance upon flowers that close
 Their gorgeous colours from the eye of day ;
 Now motionless and dark, eluded search,
 Self-shrouded ; and anon, starring the sky,
 Rose like a shower of fire."

The lantern-flies of South America and China are hemipterous insects. Their light does not proceed, as in fire-flies and glow-worms, from luminous tubercles on the thorax and abdomen, but from a hollow transparent projection of the head. Hence their name of *lantern-flies*. Some species of them, particularly *fulgora laternaria** excel even fire-flies in brilliancy. Travellers describe the trees on the banks of the Meinam, which are studded with multitudes of these living brilliants, some at rest and others in motion, as presenting at night a superlatively splendid appearance. One of them is sufficiently bright to read a newspaper by.

EMMA.

Of what use is this light to the insect ?

MR. B.

That is scarcely more satisfactorily ascertained than its nature. In some it may be a means of defence to distract or alarm their enemies ; in

* Plate III. Fig. 7.

others, it may serve to guide them either to their mates or in the pursuit of prey. It is remarkable that most of them appear to possess the power of kindling or extinguishing it at pleasure.

The *ignes fatui*, commonly called Jack o'lanterns, that used in former days so to alarm country people, are now known to be, in many cases at least, nothing more than luminous insects. One of them, once encountered by some valiant yeomen in Cambridgeshire, proved to be a mole cricket.

EMMA.

Why were country people so terrified?

MR. B.

Various superstitions have been entertained respecting these lights. Some have believed them to be souls come all on fire out of purgatory, to move the pitying spectators to say masses for their deliverance; others, evil spirits seeking from mere love of mischief, to mis-lead benighted travellers. He comes

“ On purpose to deceive us,
And leading us makes us to stray
Long winter nights out of the way,
And when we stick in mire or clay,
He doth with laughter leave us.”

A traveller in England in the sixteenth century, records, that on the road from Canterbury to Dover, so many jack o'lanterns appeared that he and his party were greatly amazed and frightened.

MRS. B.

Among the numerous advantages of science, not the least are the means it affords of explaining many appearances that were formerly regarded with alarm. How different the feelings of those who look at these vagrant lights as the mazy dance of sportive insects, and hear the little beetle's tick as the voice of love and friendship to its kind, from theirs who regard the one as evil spirits on mischief bent, and listen to the other as the death knell of some endeared relative!

MR. B.

The mind that is intelligently relieved from superstitious apprehensions, is freed from much needless suffering.

It would be waste of time to tell how, not only death-watches and jack o'lanterns, but death's-head moths, crickets, lady-birds and bees, with many others of these little harmless beings, have been supposed to influence the destinies of man, and have been courted or avoided as superstition dictated. One more terrific prodigy connected with our

subject I cannot forbear to name:—You have heard of *showers of blood* as among the fearful portents of many gloomy periods.

FREDERICK.

I remember Ovid commemorates an occurrence of the kind among the prodigies which took place after the death of the great dictator:—

“With threatening signs the lowering skies were fill’d,
And sanguine drops from murky clouds distill’d.”

MR. B.

In Stowe’s *Chronicle* we have two accounts of showers of blood in our own country; one of them “occurred in the time of Brithricus, king of the West Saxons, (about 790 A. D.,) when it rained blood, which falling on men’s clothes, appeared like crosses.” In the reign of Octavius, we are told, blood fell in Egypt, and in that of Nero, in Italy, tinging the rivers with a red colour. Two similar instances of showers of blood are recorded in the tenth century; one in the eleventh; two in the twelfth; one in the thirteenth; two in the fourteenth; one in the fifteenth; and five in the sixteenth. About the end of that century, it began to be suspected by men of science, that these phenomena were attributable to insect sources; and subsequent

observations have confirmed the suspicion, and dispelled the gloom hitherto attendant on these appearances, by proving that the sanguineous showers, at sight of which the stoutest hearts had quailed, are really nothing more than drops of a red liquid which some papilionaceous insects, and especially the peacock, nettle, and atalanta butterflies, emit on quitting the puparium.

This is but one of numerous instances in which an appearance deemed supernatural, and of which priestcraft had availed itself to impose on the ignorant, has been stripped by science of its terrors, and assigned to its right place among the great and curious works of a beneficent Creator.

I regret to find that the hour which I had allotted this evening to our interesting subject is more than expended, and that we cannot for the present pursue it further. I believe, however, that the end proposed by our entomological discussions has been answered, and that my dear Emma will in future look with as much pleasure at insects, as at the plants and flowers which they inhabit and adorn.

The End.



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